

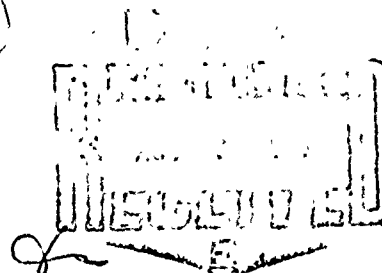
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PROPELLANT ACTUATED DEVICES ENGINEERING MANUAL

NOTICE

This manual includes items which were developed to perform at an upper temperature of 160°F. Certification is hereby made that these items also meet the 200°F environmental requirements of MIL-C-25918. Details on this and information relating to the use of items in specific applications will be furnished on request to:

Commanding Officer
Frankford Arsenal
Attn: Propellant Actuated Devices Labs.
SMUFA-J5400
Phila., Pa. 19137

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ENGINEERING MANUAL

FOR

PROPELLANT ACTUATED DEVICES

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15 JUNE 1969

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*i	15 April 1969	*2-35	15 April 1969	*Title (Section VI) .	15 April 1969
*ii	15 April 1969	2-36 and 2-37	Original	*6-1 thru 6-8	15 April 1969
*iii	15 April 1969	2-38 Blank	Original		
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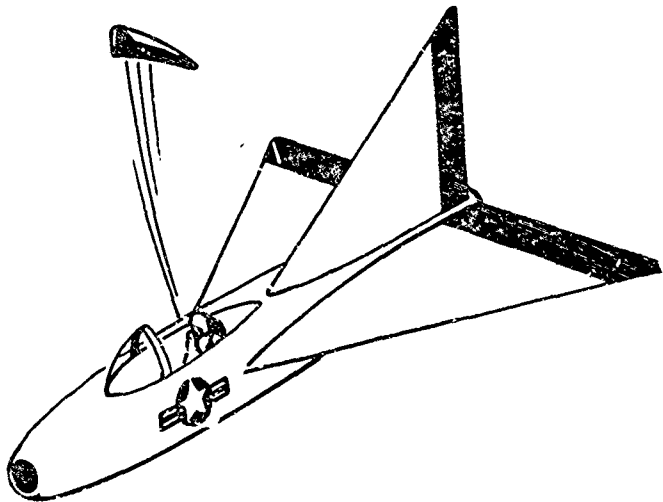
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INTRODUCTION

The major purpose of this Engineering Manual is to provide technical personnel of industries involved in design and provisions for emergency escape from extra-terrestrial vehicles, a convenient reference of basic design and performance characteristics of Propellant Actuated Devices. Since the advent of high-speed jet aircraft generated the need for an automated means of escape from aircraft, Frankford Arsenal has pioneered the design and development of Propellant Actuated Devices; such as Catapults, Initiators, Thrusters, Removers and Rocket Catapults.

The major consideration in the design, development and production of the devices described in this Manual was to attain an optimum Reliability Design Goal. Fundamental to the theory of reliability is the relationship between total and component reliabilities. On this basis, total reliability can be no greater than the least reliable component. To attain this goal, the devices listed in this Manual undergo stringent quality control tests and analysis for the propellant, pyrotechnic and hardware components, and finally the complete loaded and assembled device.



SECTION I

REMOVERS

Propellant Actuated Devices

Removers

INTRODUCTION

Description:

The remover is a two or three tube telescoping device, containing an explosive component, designed to jettison the canopy from high-speed aircraft prior to the ejection of crewmen from disabled aircraft.

The Removers are of two basic types, i.e., mechanical and gas actuated. A third type is the electric-mechanical ballistic types which permits normal opening and closing of the canopy as well as emergency jettisoning of the canopy.

Removers

REMOVER, AIRCRAFT CANOPY, M1A3

The M1A3 Remover is a three-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

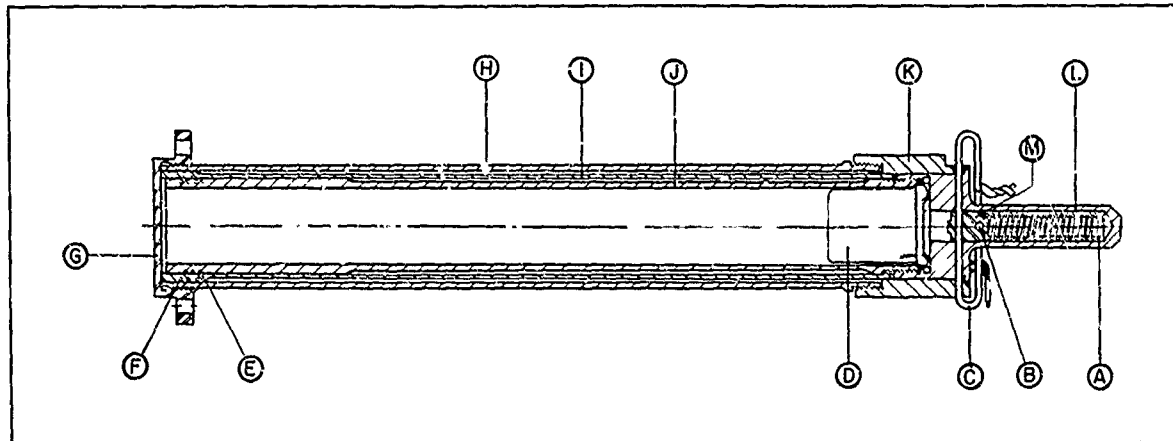
The remover is approximately 16 inches long and 1.93 inches in diameter. The remover has the M1A1 Firing Pin Release attached. The firing pin release, which when functioned by the M3A1 Initiator, releases a spring loaded firing pin in the remover. The spring propels the firing pin which strikes and detonates the primer, thereby igniting the black powder and propellant in the M29A2 Cartridge. The remover thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaneously until the shoulder of the telescoping tube comes in contact with the telescoping tube stop, thus restricting its movement. The continuous moving head assembly and inside tube are jettisoned with the aircraft canopy. The base, outside and telescoping tubes, and telescoping tube stop remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	23.3 inches
Weight (total assy)	2.1 pounds
Propelled Weight	300 pounds
Temperature Limits	-65°F to +160°F
Velocity, min (at 70°F)	20.0 fps
Thrust, min (at 70°F)	2800 pounds
Stroke Time (at 70°F)	0.135 seconds
Firing Method	Gas Actuation of the M1A1 Firing Pin Release, which releases M1A3 Remover Firing Pin

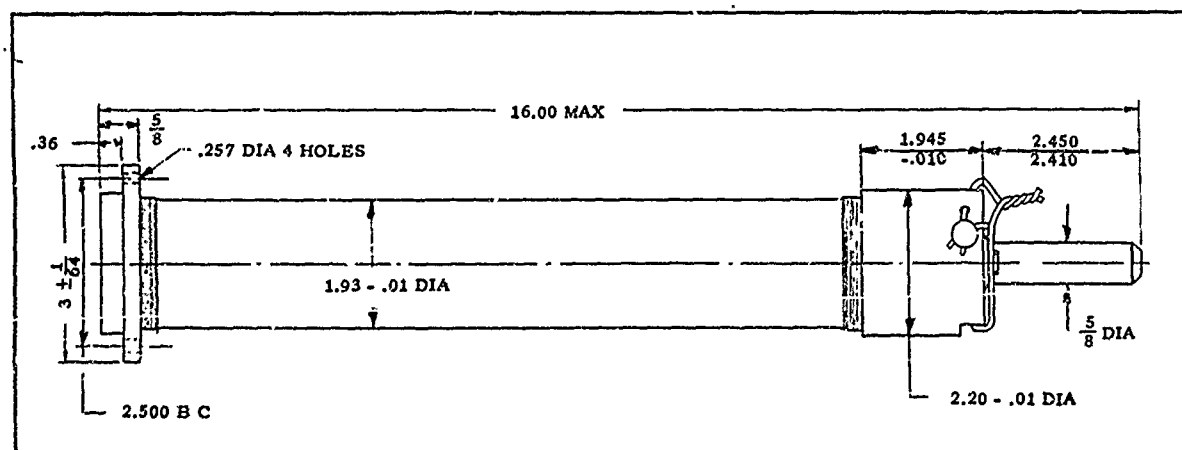
Propellant Actuated Devices

Remover, Aircraft Canopy, M1A3



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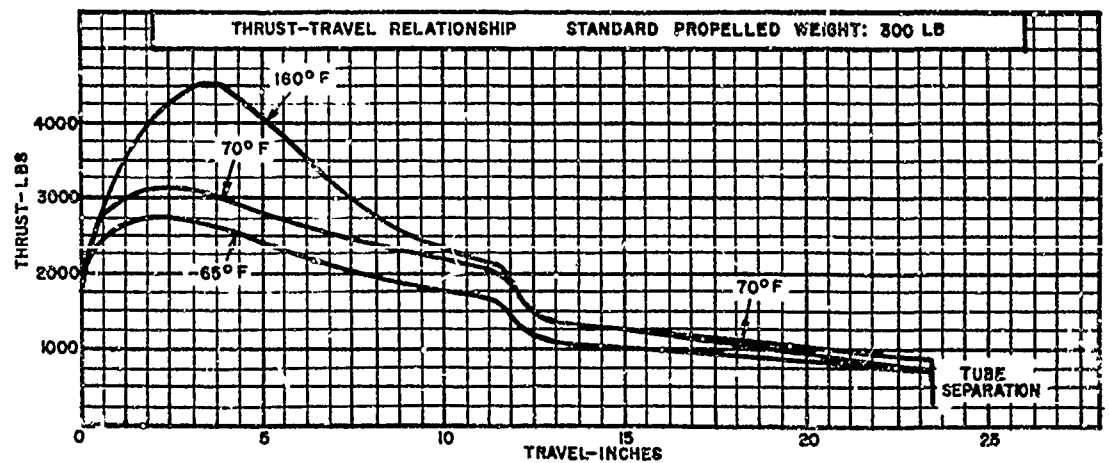
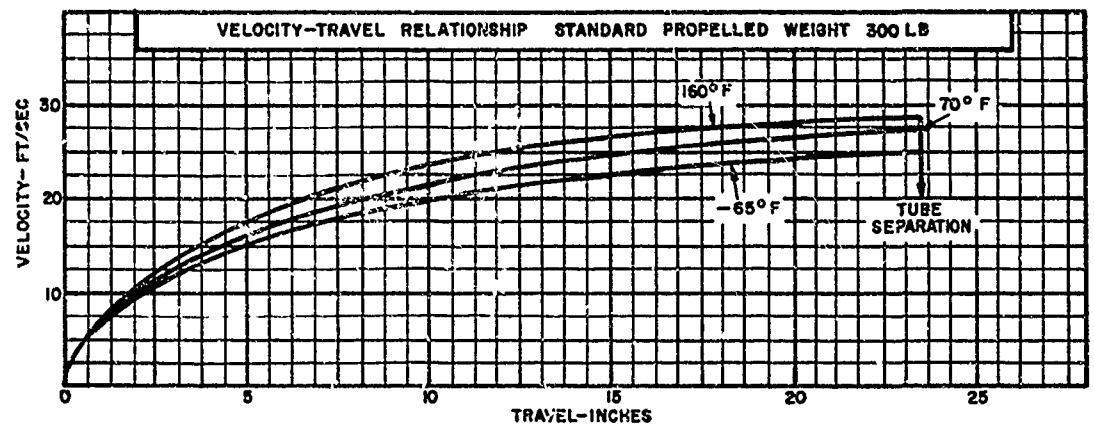
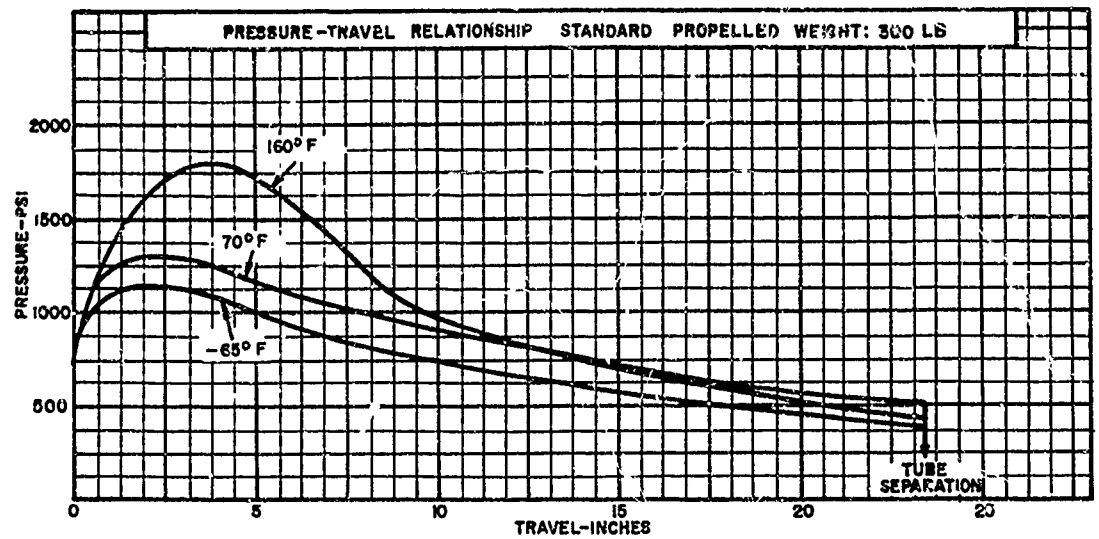
Component	Component
A Spring, Firing Pin	G Base
B Pin, Safety	H Tube, Outside and Peller Assembly
C Wire, Locking, .062" x 8"	I Tube, Telescoping
D Cartridge, Aircraft Canopy Remover, M29A2	J Tube, Inside and Peller Assembly
E Seal, Inside	K Stop, Telescoping Tube
F Seal, Telescoping	L Head, Firing
	M Pin, Firing



ENVELOPE DRAWING

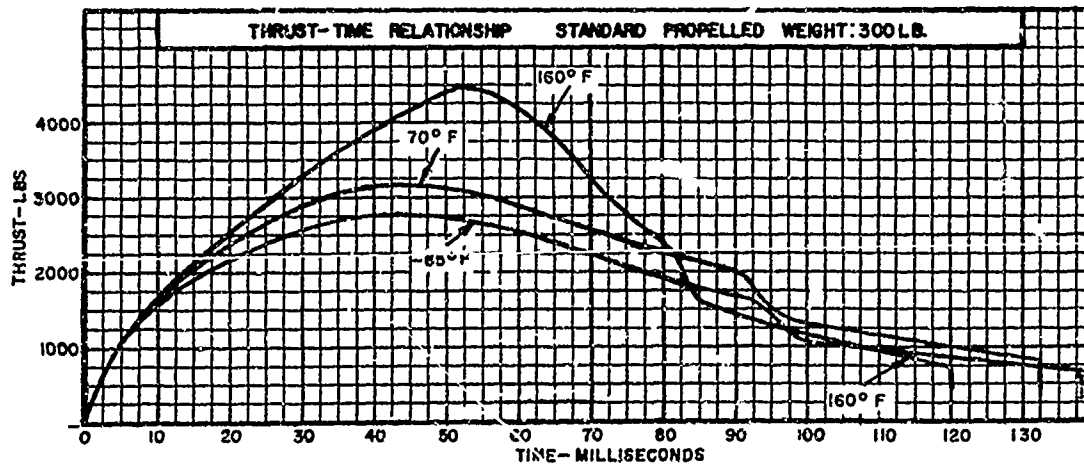
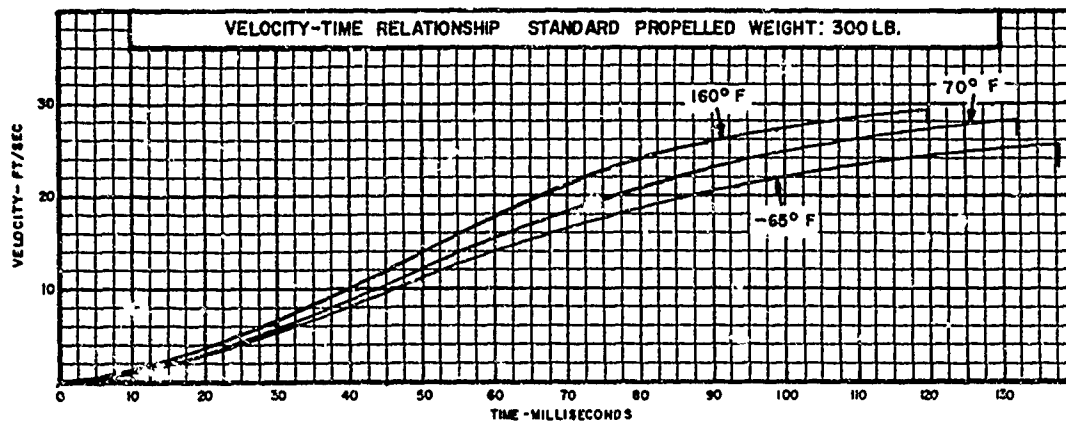
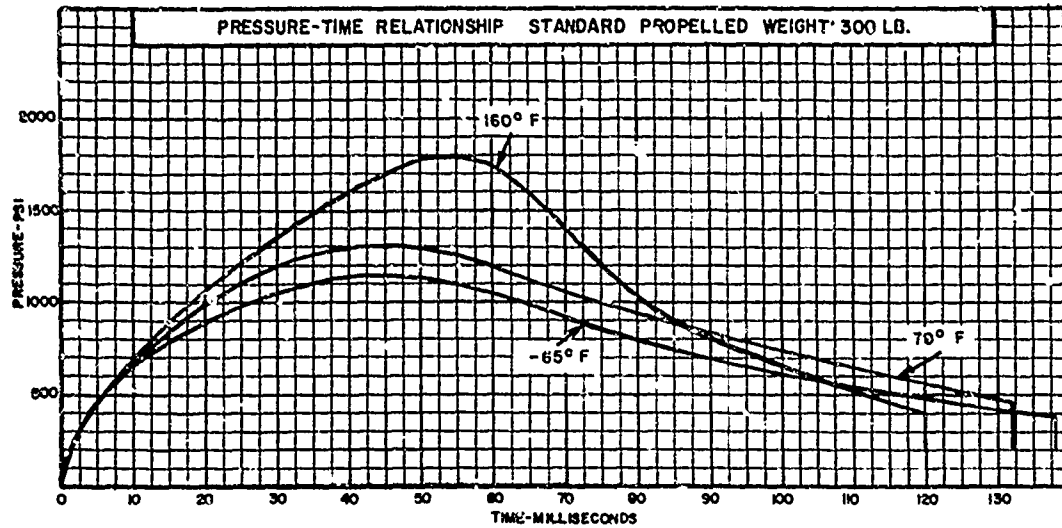
Propellant Actuated Devices

Remover, Aircraft Canopy, M1A3



Propellant Actuated Devices

Remover, Aircraft Canopy, M1A3



Propellant Actuated Devices

Removers

REMOVER, AIRCRAFT CANOPY M2A1

The M2A1 Remover is a two-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

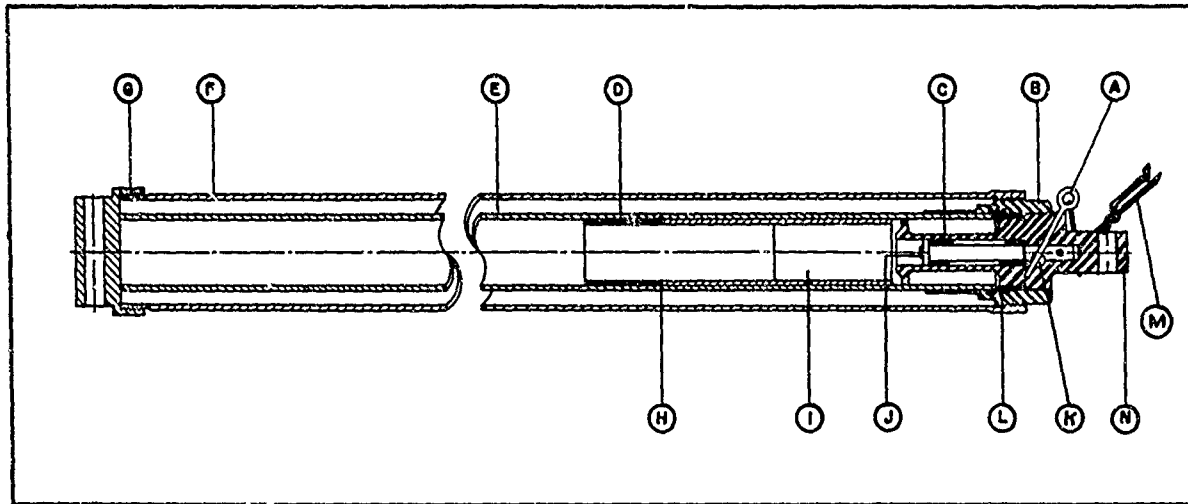
The remover is approximately 31 inches long and 2.19 inches in diameter. The remover is actuated by removal of the safety locking pin first and the manual rotation of the sear through a pulley system connected to a lever on the pilot's seat. Rotation of the sear releases a spring loaded firing pin and unlocks the inside tube. The firing pin is propelled forward and detonates the primer, thereby igniting the black powder and propellant in the M31A1 Cartridge. The remover thrust which is developed from the expanding gases of the burning propellant, forces the inside tube outward. The block assembly and inside tube are jettisoned with aircraft canopy. The cap and outside tube remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	26.0 inches
Weight	4.4 pounds
Propelled Weight	300 pounds
Temperature Limits	-65° to +160°F
Velocity, min (at 70°F)	20.5 fps
Thrust, min (at 70°F)	2600 pounds
Stroke Time (at 70°F)	0.150 seconds
Firing Method	Mechanical Actuation

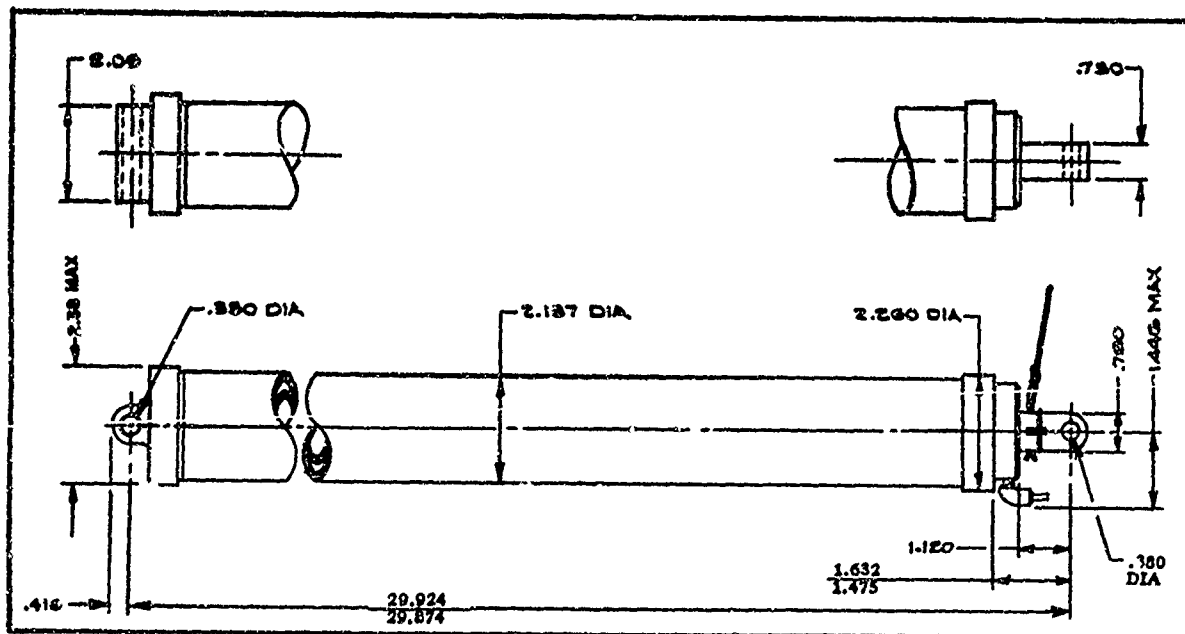
Propellant Actuated Devices

Remover Aircraft Canopy, M2A1



CROSS-SECTION DRAWING

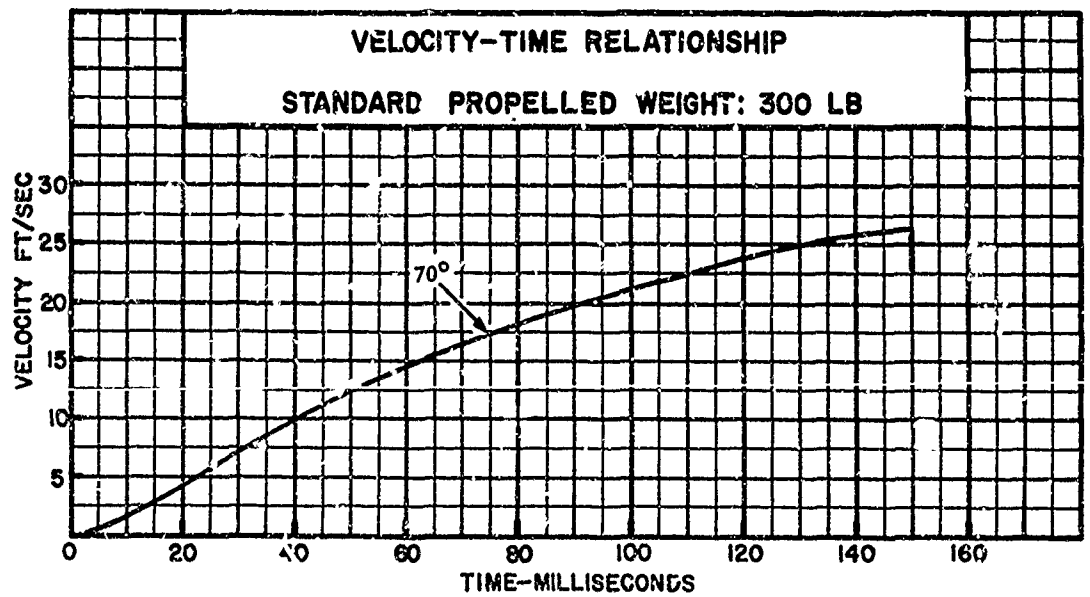
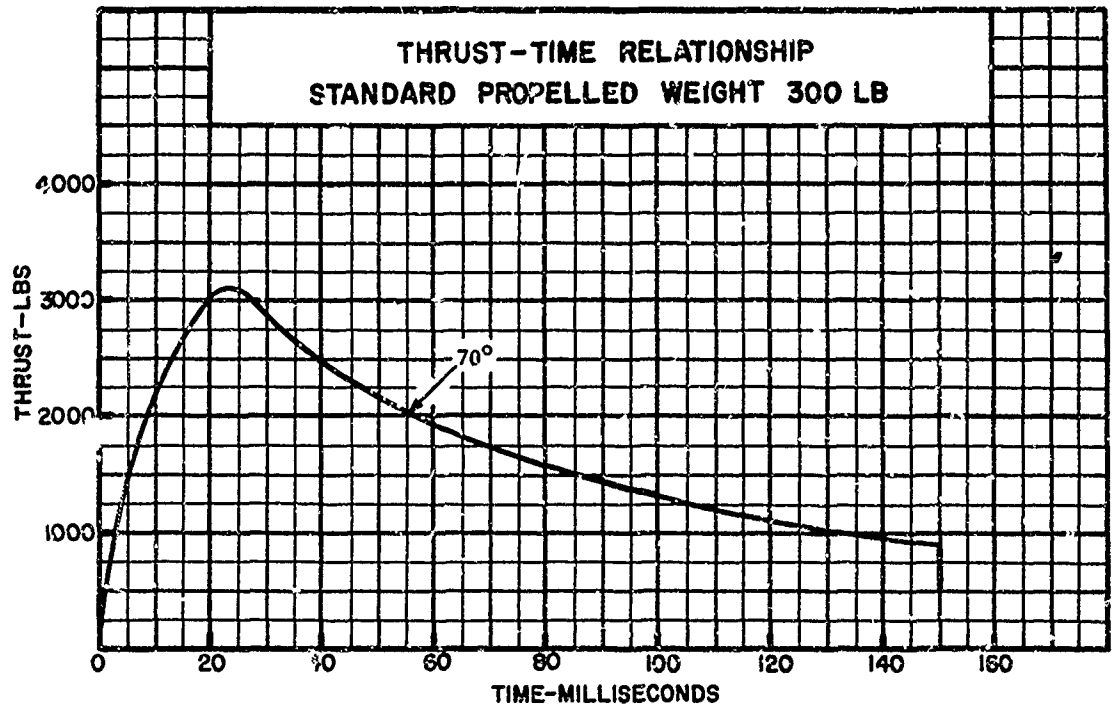
Component	Component
A Pin, Locking	I Cartridge, Aircraft Canopy Remover, M31A1
B Tube, Bearing	J Pin, Firing
C Spring, Firing Pin	K Sear
D Sleeve	L Spring
E Tube, Inner	M Safety Pin Assembly
F Tube, Outside	N Block Assembly
G Cap	
H Ring, Retaining	



ENVELOPE DRAWING

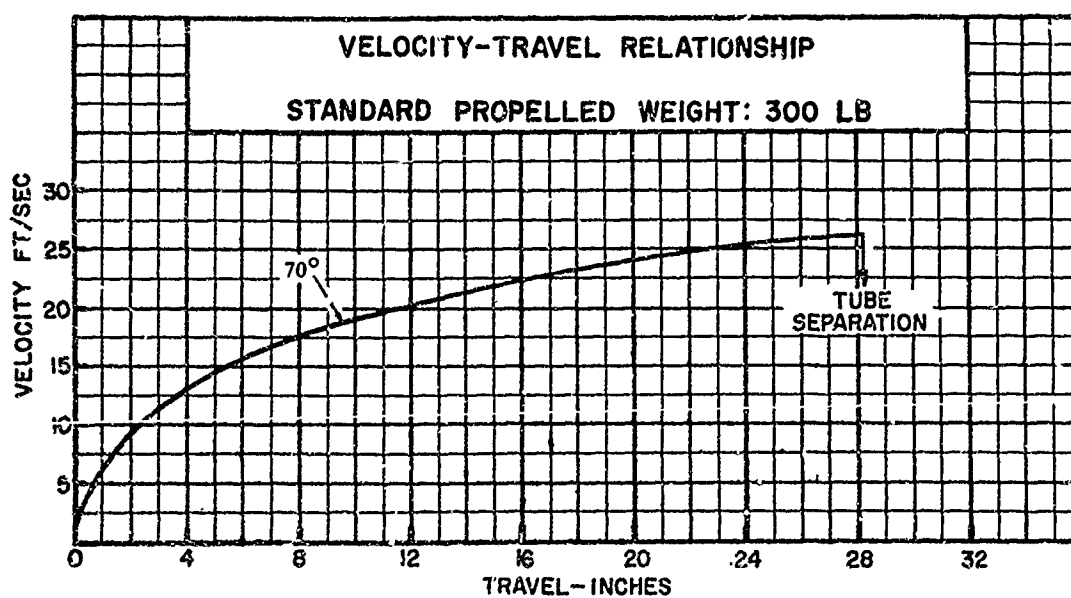
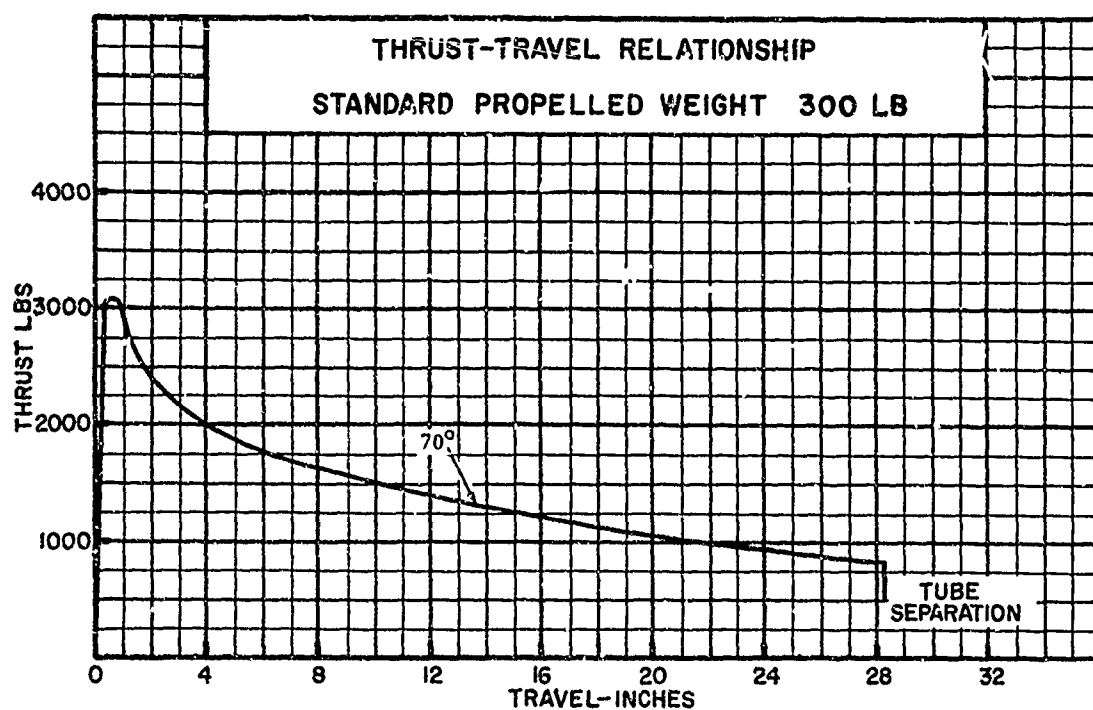
Propellant Actuated Devices

Remover, Aircraft Canopy, M2A1



Propellant Actuated Devices

Remover, Aircraft Canopy, M2A1



Propellant Actuated Devices

Removers

REMOVER, AIRCRAFT CANOPY, M3A1

The M3A1 Remover is a two-tube ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

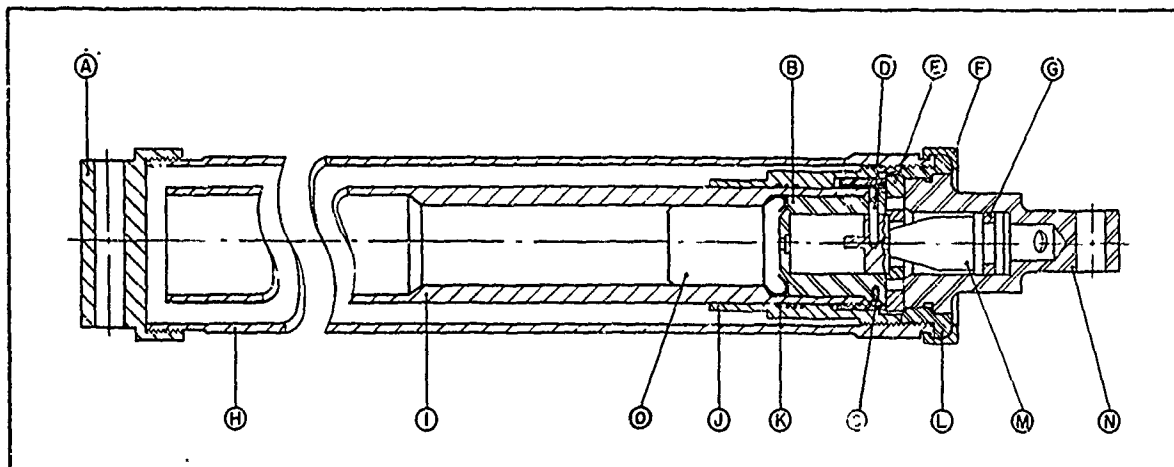
The remover is approximately 31 inches long and 2.19 inches in diameter. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M31A1 Cartridge. The remover is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The remover thrust which is developed from the expanding gases of the burning propellant, forces the inside tube outward. The block assembly and inside tube are jettisoned with the aircraft canopy. The cap and outside tube remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	26.0 inches
Weight (total assy)	4.4 pounds
Propelled Weight	300 pounds
Temperature Limits	-65° to +160°F
Velocity, min (at 70°F)	20.5 fps
Thrust, min (at 70°F)	2600 pounds
Stroke Time (at 70°F)	0.150 seconds
Firing Method	Gas Actuation

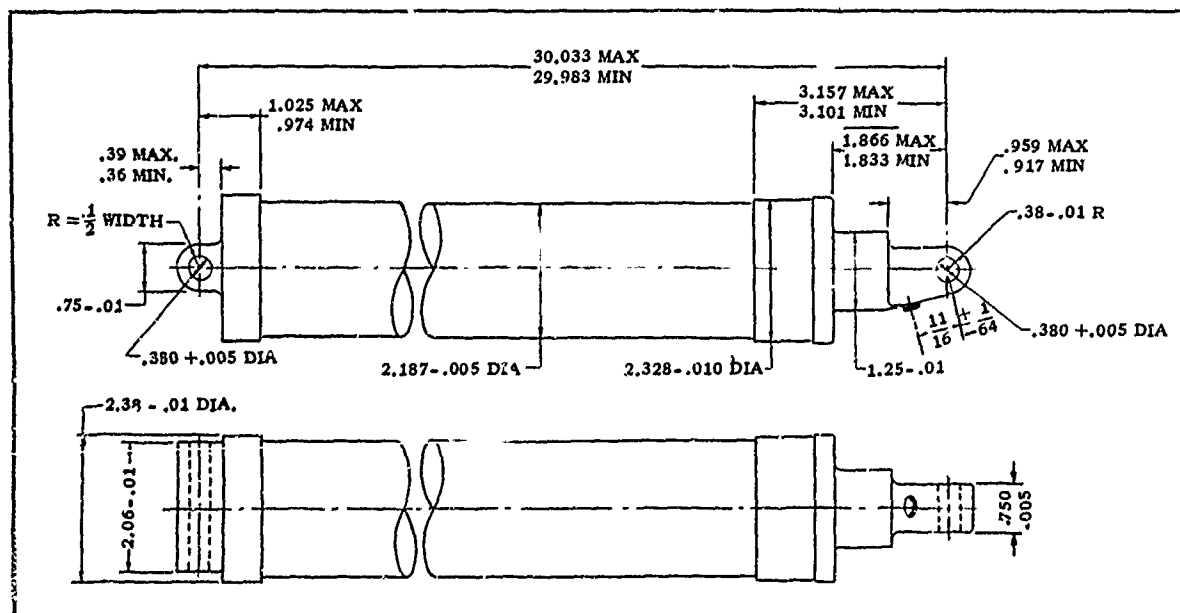
Propellant Actuated Devices

Remover Aircraft Canopy, M3A1



CROSS-SECTION DRAWING

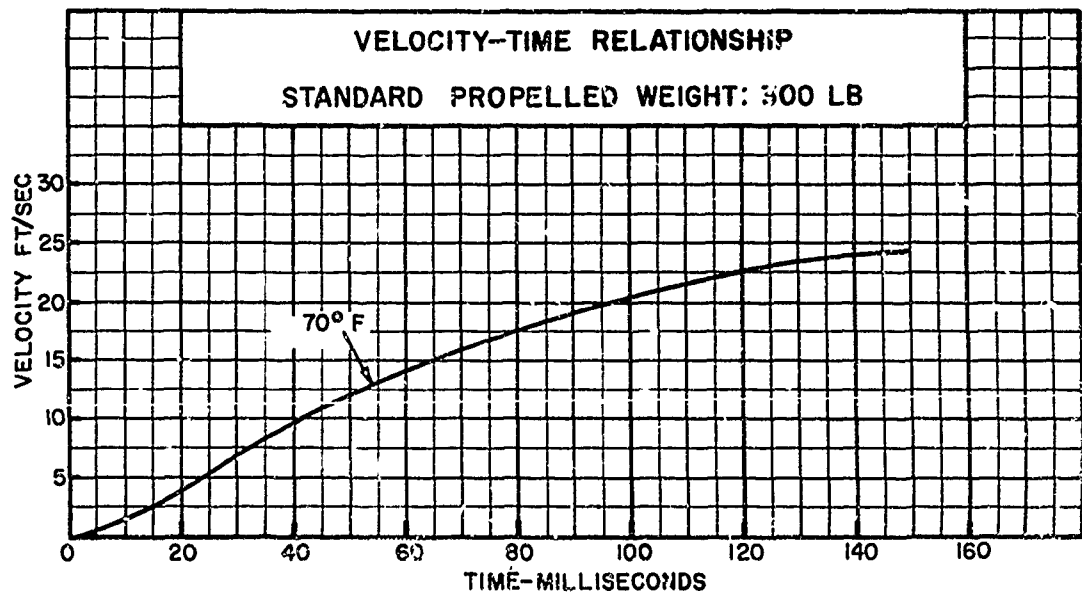
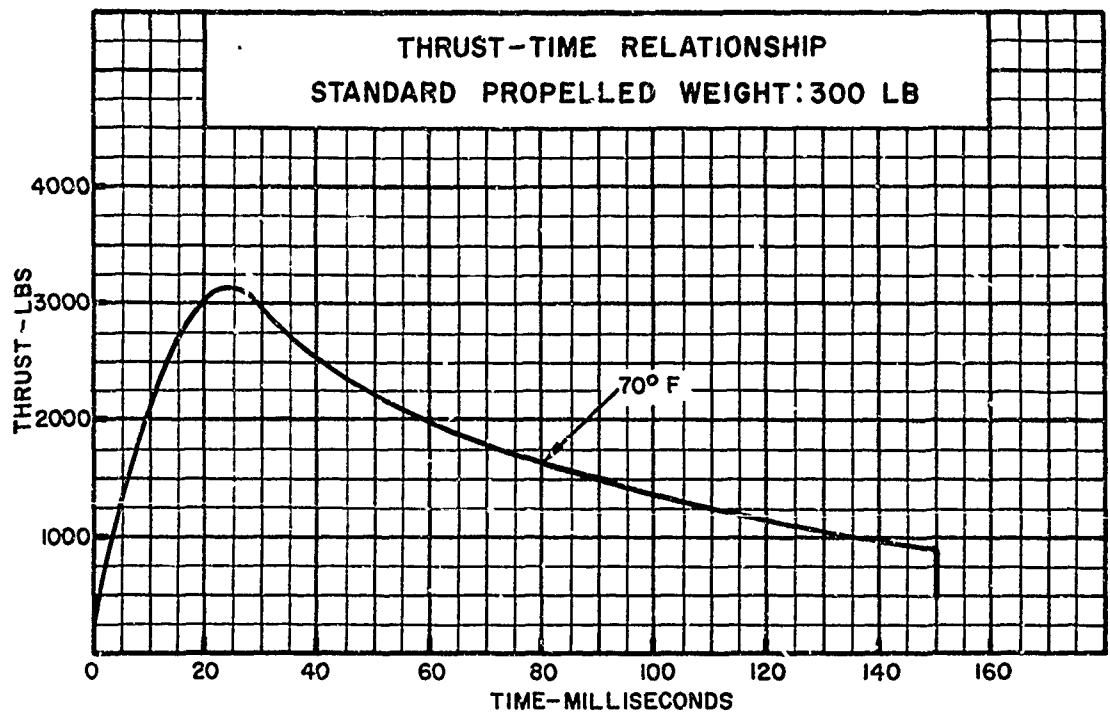
Component	Component
A Cap	H Tube, Outside and Pellet Assembly
B Plug	I Tube, Inside and Pellet Assembly
C Screw, Cap, Socket Head, Self Locking (Shown 90° Out of Position)	J Tube, Bearing and Pellet Assembly
D Pin, Shear	K Seal, Fixed
E Latch	L Ring, Stop and Pellet Assembly
F Pipe Plug (for shipping only)	M Pin, Firing
G "O" Ring	N Block
	O Cartridge, Aircraft Canopy Remover, M31A1



ENVELOPE DRAWING

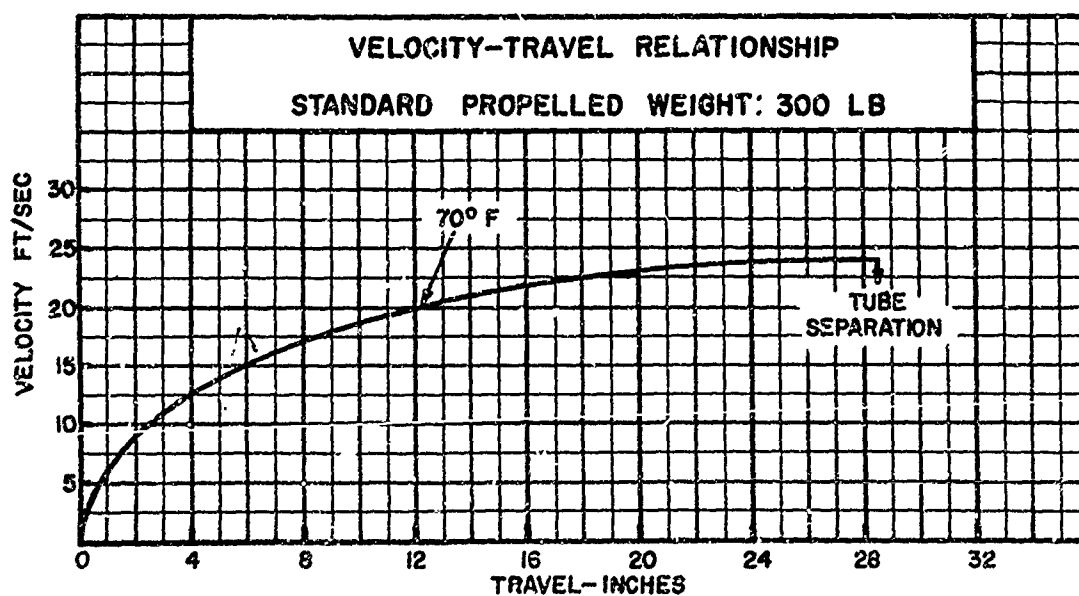
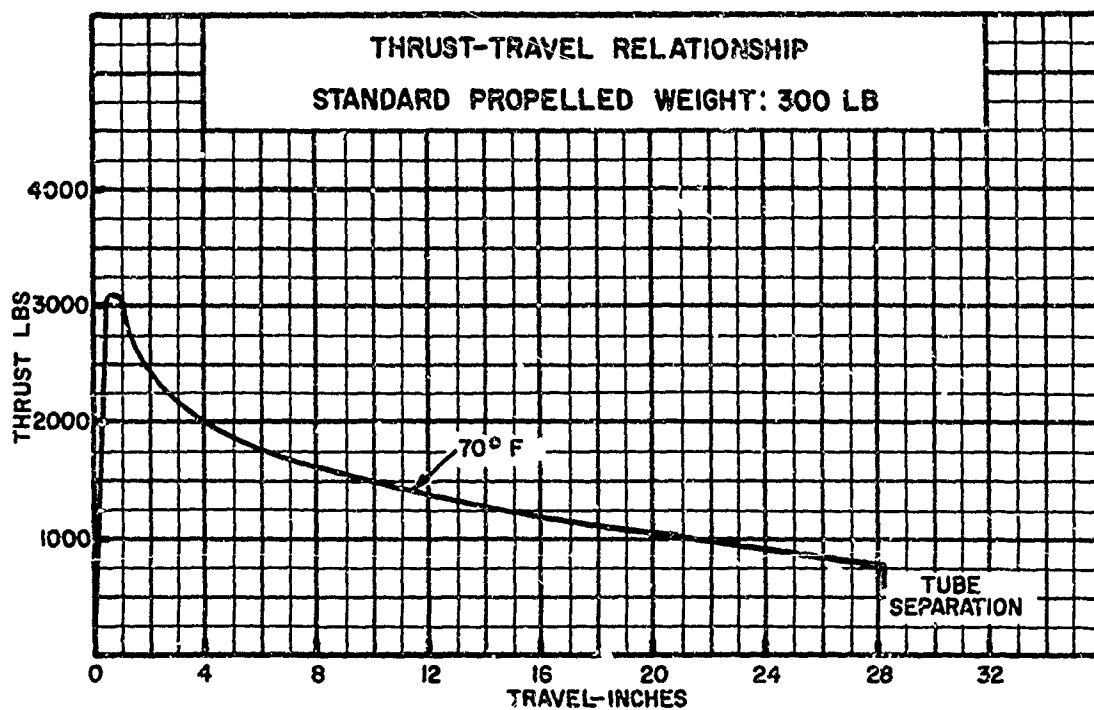
Propellant Actuated Devices

Remover, Aircraft Canopy, M3A1



Propellant Actuated Devices

Remover, Aircraft Canopy, M3A1



Removers

REMOVER, AIRCRAFT CANOPY, M4

The M4 Remover is a three-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high-speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

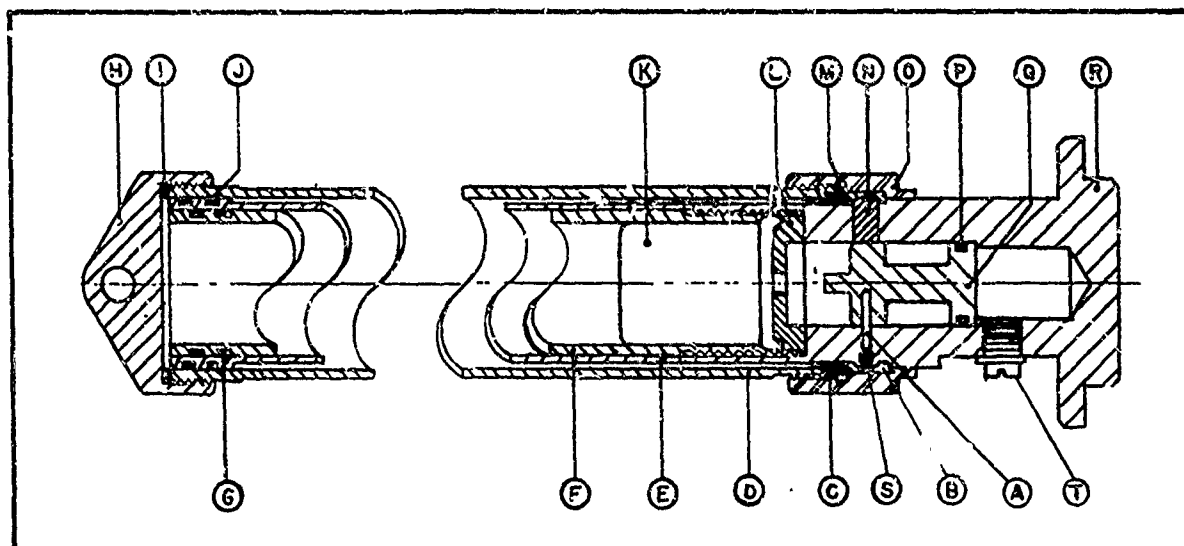
The remover is approximately 14.67 inches long and 1.93 inches in diameter. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M29A2 Cartridge. During the forward motion of the firing pin, the locking keys slide inward, thus unlocking the remover. The remover thrust which is developed from the expanding gases of the burning propellant, forces the outside tube to travel forward until the washer engages the shoulder on the telescoping tube. The telescoping tube is then pulled forward by the outer tube until it is free of the inside tube, and is jettisoned with the canopy. The inside tube and firing head assembly remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	19.0 inches
Weight (total assy.)	3.84 pounds
Propelled Weight	300 pounds
Temperature Limits	-65° to + 160°F
Velocity, min (at 70°F)	20 fps
Thrust, min (at 70°F)	2800 pounds
Stroke Time (at 70°F)	0.114 seconds
Firing Method	Gas Actuation

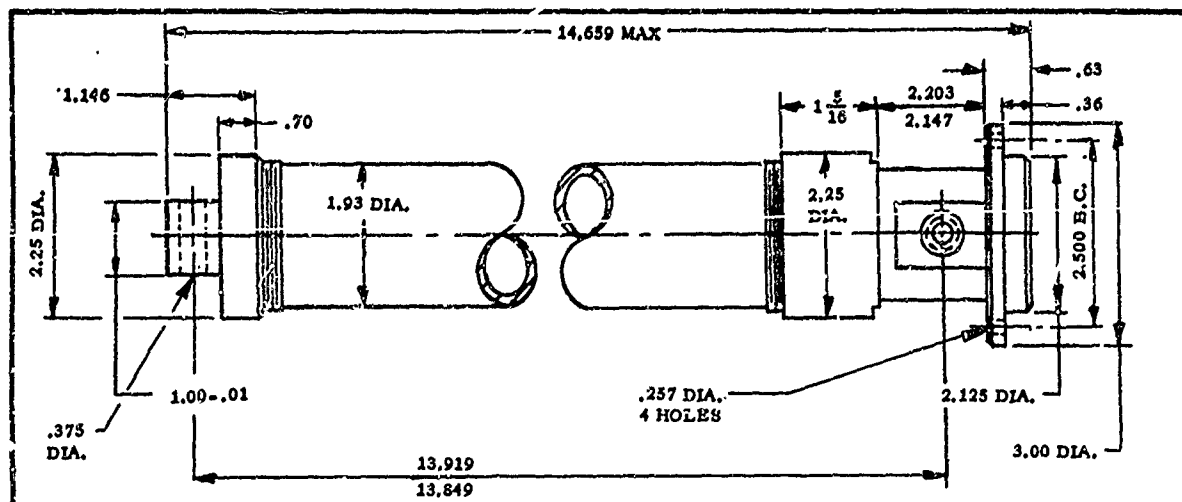
Propellant Actuated Devices

Remover, Aircraft Canopy, M4



CROSS-SECTION DRAWING

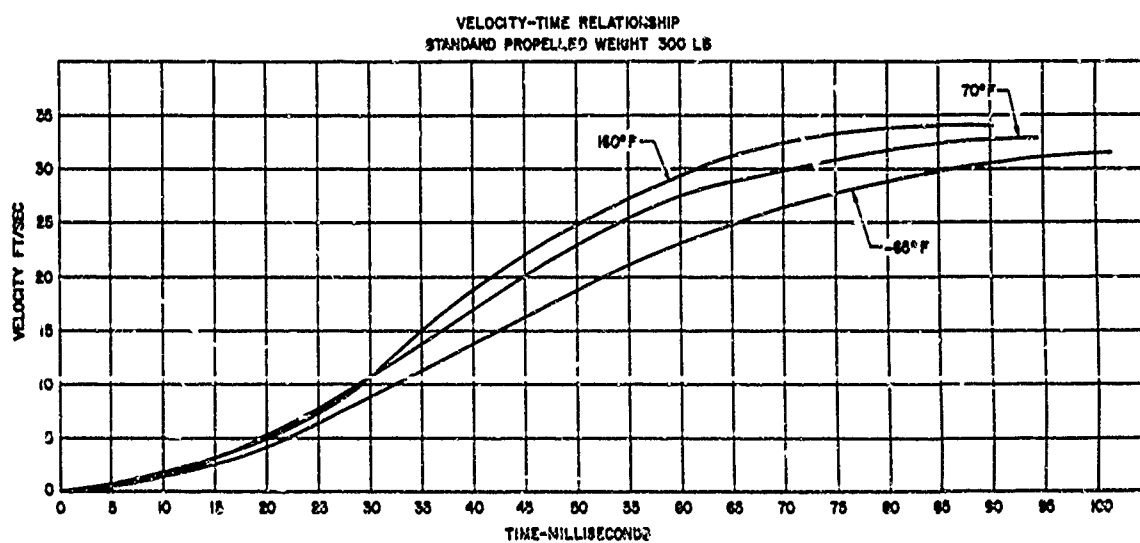
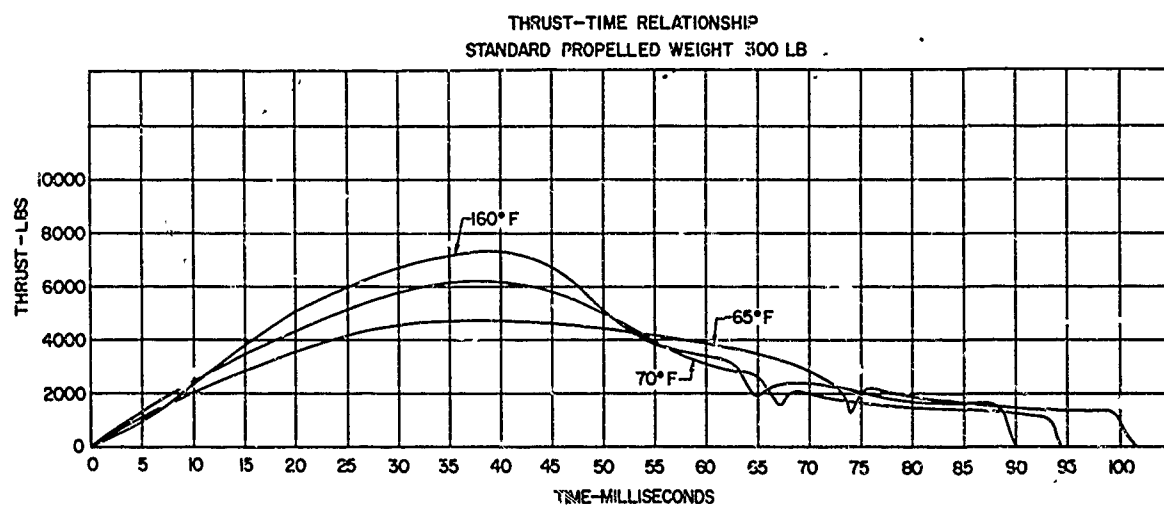
Component	Component
A Pin, St.ear (Shown 90° out of position)	L Stop, Firing Pin
B Ring, Retaining	M Washer
C Ring, Sealing	N Key, Locking (2)
D Tube, Outside	O Sleeve
E Tube, Telescoping	F "O" Ring
F Tube, Inside	Q Pin, Firing
G Ring, Sealing	R Head, Firing
H Cap	S Screw, Set (Shown 90° out of position)
I Gasket	T Shipping Plug
J Ring, Sealing	
K Cartridge, Aircraft Canopy Remover, M120	



ENVELOPE DRAWING

Propellant Actuated Devices

Remover, Aircraft Canopy, M4



Removers

REMOVER, AIRCRAFT CANOPY, M5

The M5 Remover is a three-tube, telescoping ejection device containing an explosive cartridge, designed to forcibly jettison the canopy from high speed aircraft to provide a safe path for the ejection of the crewman from disabled aircraft.

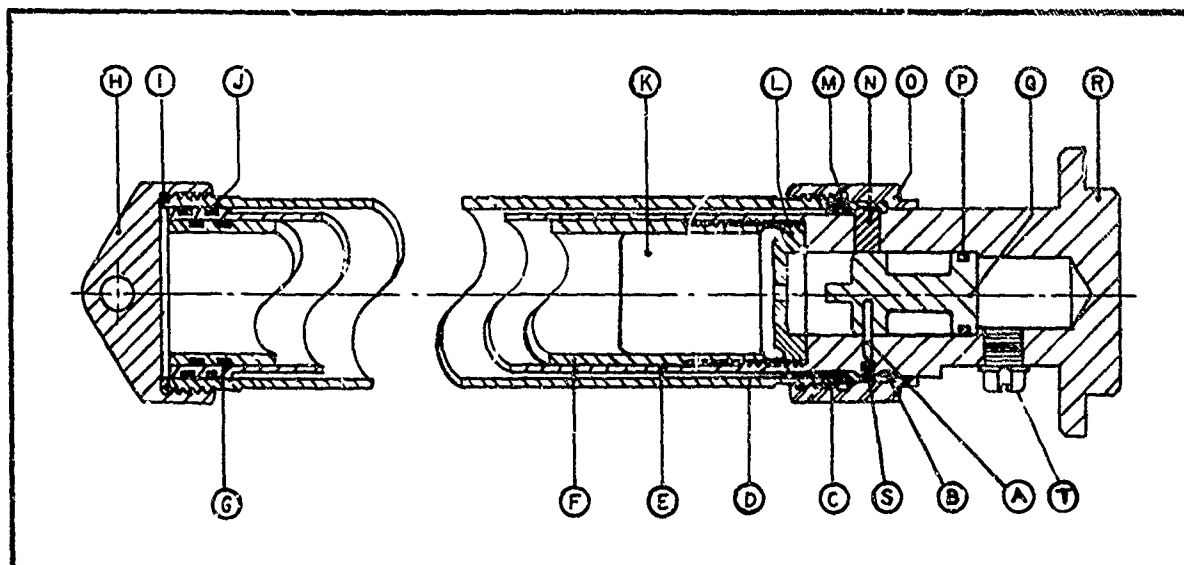
The remover is approximately 14.67 inches long and 1.93 inches in diameter. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose exerting force against the remover firing pin. The firing pin is propelled forward, strikes and detonates the primer, thereby igniting the black powder and propellant in the M120 Cartridge. During the forward motion of the firing pin, the locking keys slide inward, thus unlocking the remover. The remover thrust which is developed from the expanding gases of the burning propellant, forces the outside tube to travel forward until the washer engages the shoulder on the telescoping tube. The telescoping tube is then pulled forward by the outer tube until it is free of the inside tube and is jettisoned with the canopy. The inside tube and firing head assembly remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	19.0 inches
Weight (total assy)	3.84 pounds
Propelled Weight	1000 pounds
Temperature Limits	-65° to +160°F
Velocity, min (at 70°F)	10 fps
Thrust, min (at 70°F)	4500 pounds
Firing Method	Gas Actuation

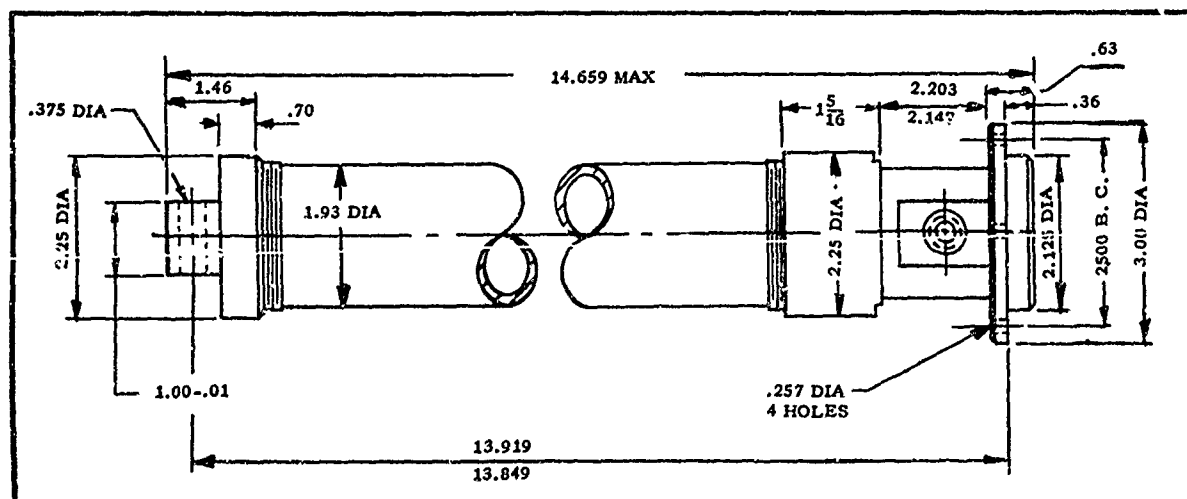
Propellant Actuated Devices

Remover, Aircraft Canopy, M5



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear (Shown 90° out of position)	L Stop, Firing Pin
B Ring, Retaining	M Washer
C Ring, Sealing	N Key, Locking (2)
D Tube, Outside	O Sleeve
E Tube, Telescoping	P "O" Ring
F Tube, Inside	Q Pin, Firing
G Ring, Sealing	R Head, Firing
H Cap	S Screw, Set (Shown 90° out of position)
I Gasket	T Shipping Plug
J Ring, Sealing	
K Cartridge, Aircraft Canopy Remover, M120	



ENVELOPE DRAWING

Removers

REMOVER, AIRCRAFT CANOPY, M8A1

The M8A1 Remover is an electro-mechanical-ballistic, two tube telescoping device designed to raise and lower the F106A aircraft canopy under normal conditions during ground operation and to jettison the canopy prior to ejection of the pilot from the aircraft during emergency escape in flight or on the ground.

The electro-mechanical portion of the remover consists of a reversible, intermittent duty 26 volt direct current motor, a gear transmission with an indexing mechanism and torque limit switch, a solenoid-operated clutch with an integral ratchet mechanism, and a ball-bearing screw assembly which is coaxial with the remover ballistic chamber. Raising and lowering the aircraft canopy is accomplished by electrically energizing the remover motor which transmits rotary motion through the gear system to the clutch. As the clutch rotates the ball-bearing screw turns within a non-rotating ball nut, which is attached to the inside tube of the remover. Rotation of the ball-bearing screw drives the remover inside tube outward, raising the canopy; or inward, lowering the canopy, when the motor is electrically reversed. As the inside tube extends 9.38 inches, power to the motor is shut off automatically by an extension limit switch which is actuated by the shoulder on the inside tube through a plunger. Upon retracting the remover inside tube and canopy, a torque limit switch de-energizes the motor when the canopy is restrained by the fuselage and a tension load of 1000 to 1450 pounds is imposed on the ball-bearing screw assembly. This cinch-down load ensures that the canopy is properly seated on the fuselage for locking by the pilot. A safety feature is incorporated in the clutch mechanism which prevents the canopy dropping to the closed position should the clutch inadvertently disengage during any position of remover stroke. The remover in the retracted position is approximately 20.25 inches long between mounting points.

The ballistic portion of the remover is used to jettison the canopy prior to ejection of the pilot from the disabled aircraft. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the cartridge primer, thereby igniting the black powder and propellant in the M150 Cartridge. Propellant gas from the cartridge expands through the opening in the adapter housing where it acts against the ballistic lock components and the inside tube. With the increase in pressure the ballistic lock unlocks the inside tube and the gas pressure forces the inside tube outward. The inside tube which is pin-mounted to the canopy, clears the outside tube and jettisons the canopy, clear of the aircraft.

Propellant Actuated Devices

Removers

PRINCIPAL CHARACTERISTICS (M8A1 Cont'd)

Weight (Total Assy)	22.5 pounds
Temperature Limits	-65° F to 200° F

Electro-Mechanical

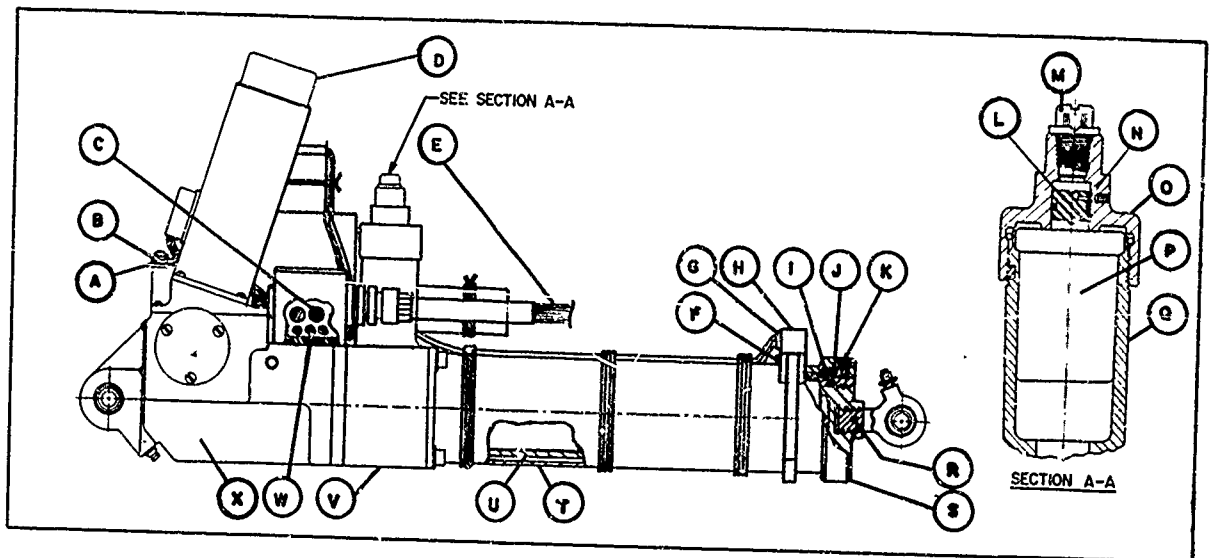
Electric Power	28 Volt D.C. System
Operating Voltage Limit	18 to 29 Volts
Operating Loads	
Overload	250 pounds (tension) to 680 pounds (compression)
Normal load	380 pounds (compression)
Overload	430 pounds (tension) to 940 pounds (tension)
Extension or Retraction Time	15 sec max; 5 sec. min.
Clutch Engage Time, max.	0.500 sec.
Clutch Disengage Time, max.	0.500 sec.
Cinch-Down Load	1000 to 1450 pounds
Stroke	8.38 to 9.38 inches

Ballistic

Stroke	12.0 inches
Propelled Weight	350 pounds
Velocity (at 70° F)	24.0 fps
Peak Thrust (at 70° F)	5400 pounds
Firing Method	Gas Actuation
Stroke Time (at 70° F)	0.150 sec.

Propellant Actuated Devices

Remover, Aircraft Canopy, M8A1



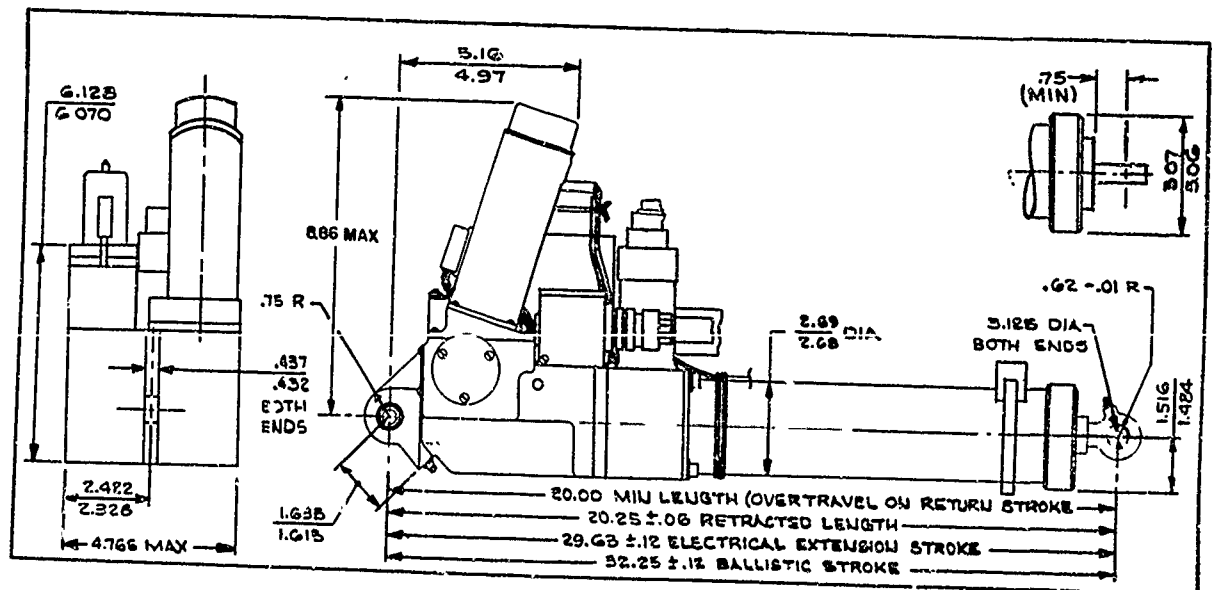
CROSS-SECTION DRAWING

Component

- A Clamp
- B Washer
- C 5-Splice, Electric
- D Motor
- E Cable Assembly
- F Screw
- G Grommet
- H Cover
- I Ring
- J "O" Ring
- K Screw, Shear
- L Pin, Firing

Component

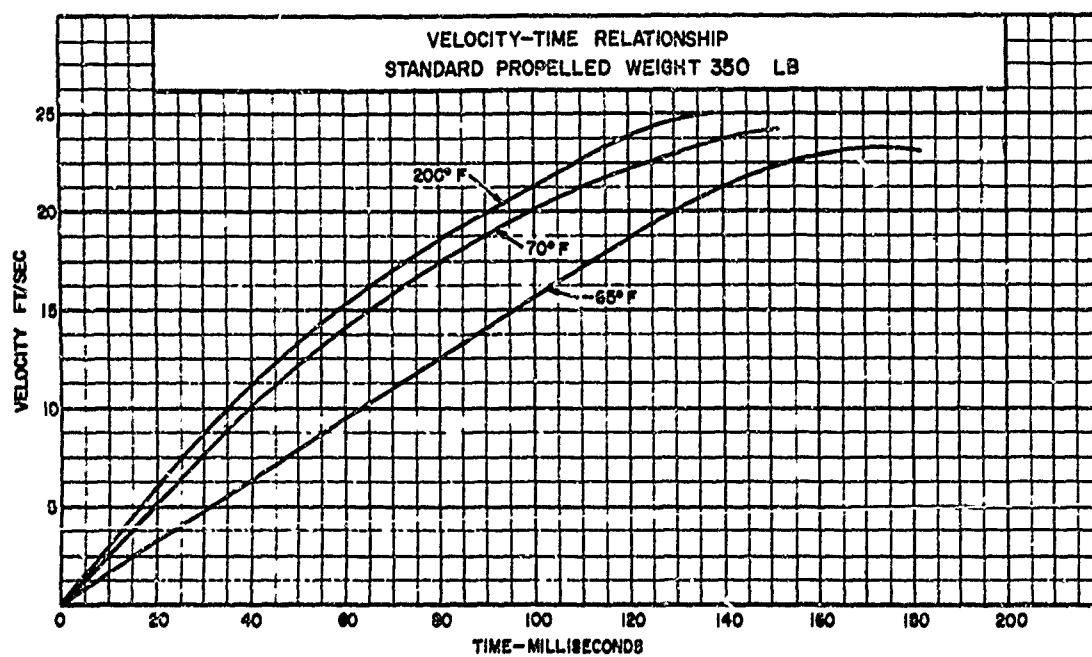
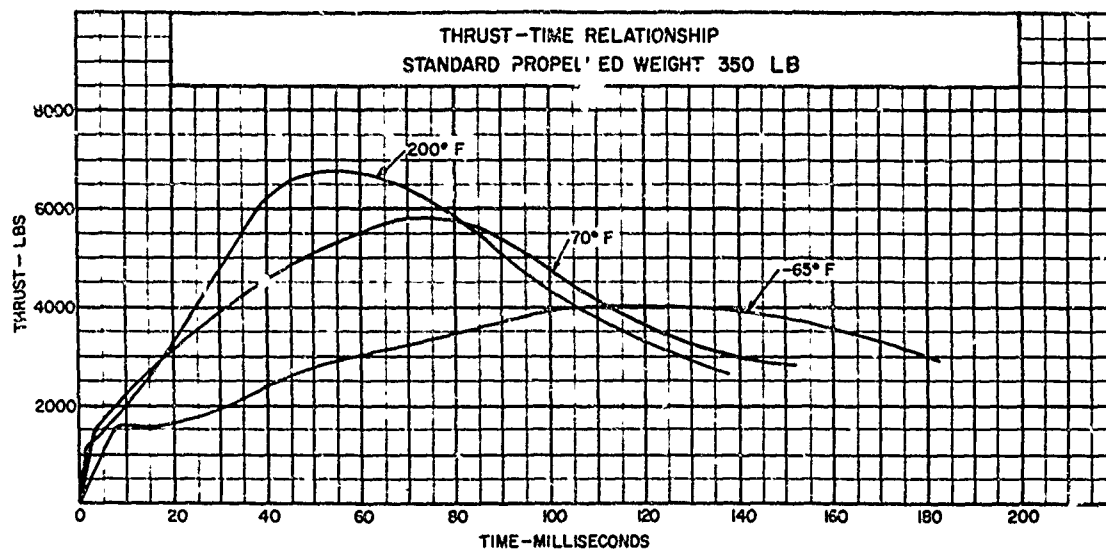
- M Plug, Shipping
- N Pin, Shear
- O Head
- P Cartridge, Aircraft Canopy Remover, M150
- Q Adapter
- R Pin
- S Ring, Shear
- T Tube, Outside, Assy
- U Tube, Inside, Assy
- V Housing
- W 9-Splice, Electric
- X Gear Box Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Remover, Aircraft Canopy, MPA1



Propellant Actuated Devices

Removers

REMOVER, AIRCRAFT CANOPY M9

The M9 Remover is an electro-mechanical ballistic, three tube telescoping device designed to raise and lower the F106B aircraft canopy under normal conditions during ground operation and to jettison the canopy prior to ejection of the pilot from the aircraft during emergency escape in flight or on the ground.

The electro-mechanical portion of the remover consists of a reversible, intermittent duty, 26 volt direct current motor, an electronic speed control box, a gear transmission, a clutch mechanism with an integral ratchet mechanism, mechanical clutch disengage mechanism, and a double ball-bearing screw assembly which is coaxial with the remover ballistic chamber. Raising and lowering the aircraft canopy is accomplished by electrically energizing the remover motor which transmit rotary motion through the gear system to the mechanically operated clutch. As the clutch rotates the ball-bearing screw turns within a non-rotating ball nut, which is attached to the inside tube of the remover through a bearing. Rotation of the ball-bearing screw drives the remover inside tubes outward, raising the canopy; or inward, lowering the canopy, when the motor is electrically reversed. As the inside tubes extend approximately 45.86 inches, power to the motor is shut off automatically by an extension limit switch which is cam actuated. Upon retracting the remover inside tubes and canopy, a torque limit switch de-energizes the motor when the canopy is restrained by the fuselage and a tension load of 400 to 500 pounds is imposed on the ball-bearing screw assembly. This cinch-down load insures that the canopy is properly seated on the fuselage for locking by the pilot. The electronic speed control box which is attached to the adapter housing is used to reduce the motor speed on the retraction stroke. A safety feature is incorporated in the clutch mechanism which prevents the canopy dropping to the closed position should the clutch inadvertently disengage during any position of remover stroke. The remover in the retracted position is approximately 23.51 inches long between mounting points.

The ballistic portion of the remover is used to jettison the canopy prior to ejection of the pilot from the disabled aircraft. The remover has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the remover firing pin. The firing pin is propelled forward and strikes and detonates the cartridge primer, thereby igniting the black powder and propellant in the M151 Cartridge. Propellant gas from the cartridge expands through the opening in the adapter housing where it acts against the ball-bearing screw assembly and the inside tube. With the increase in pressure the spring pin which secures the ball-bearing screw assembly to the bearing housing shears, and the continued production of gas pressure forces the inside tube and ball-bearing assembly outward simultaneously. The inside tube and ball-bearing assembly which is pin mounted to the canopy, clear the outside tube and jettisons the canopy clear of the aircraft.

PRINCIPAL CHARACTERISTICS

Weight (Total Assy)	35 pounds
Temperature Limits	-65°F to 200°F

PRINCIPAL CHARACTERISTICS (M9 Cont'd)

Electro-Mechanical

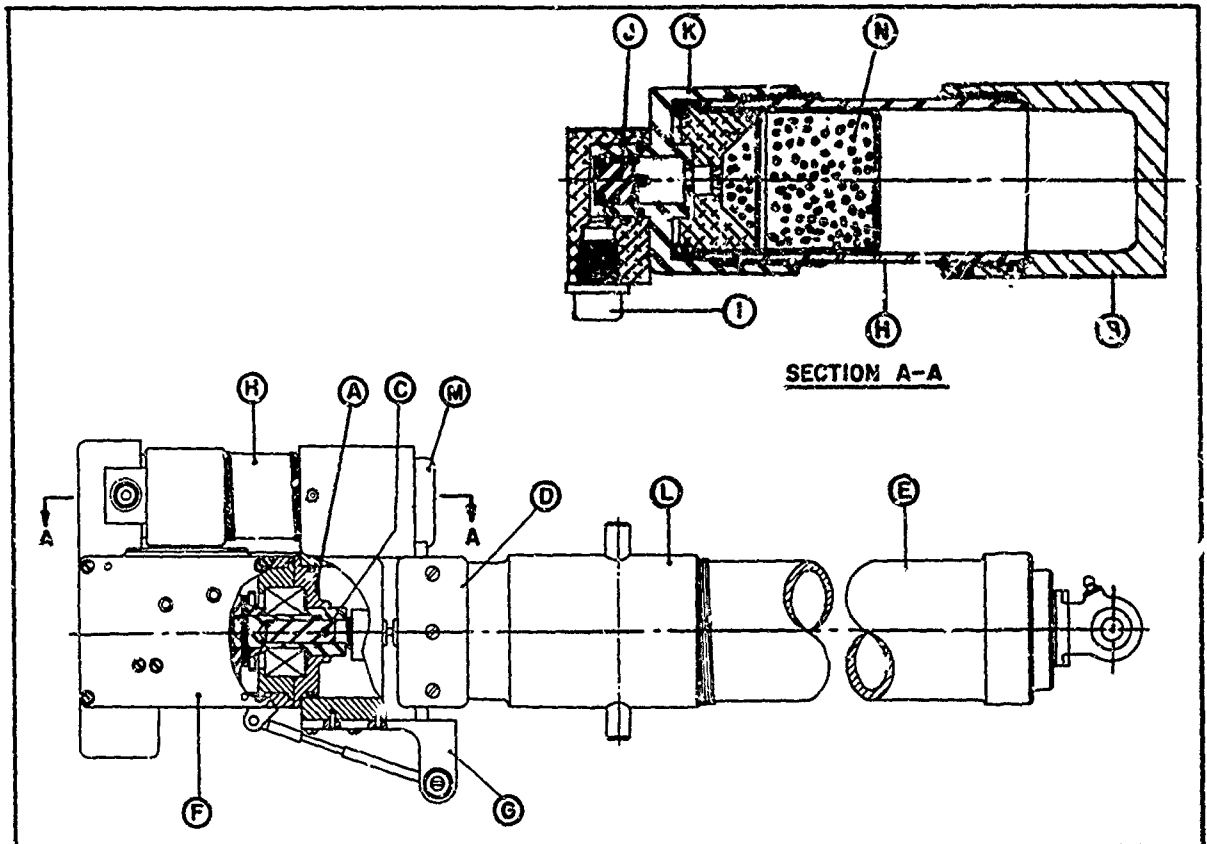
Electric Power	28 Volt D.C. System
Operating Voltage Limit	18 to 29 Volts
Operating Loads	
Overload	315 pounds (compression) to 398 pounds (compression)
Normal load	288 pounds (compression) to 228 pounds (compression)
Overload	196 pounds (tension) to 142 pounds (tension)
Extension or Retraction Time	20 sec. max; 10 sec. min.
Clutch Disengage Load	7 to 11 pounds
Cinch-Down Load	400 to 500 pounds
Stroke	45.86 inches

Ballistic

Stroke	27.0 inches
Propelled Weight	300 pounds
Velocity (at 70°F)	33.0 fps
Peak Thrust (at 70°F)	6000 pound
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.090 sec.

Propellant Actuated Devices

Remover, Aircraft Canopy, M9



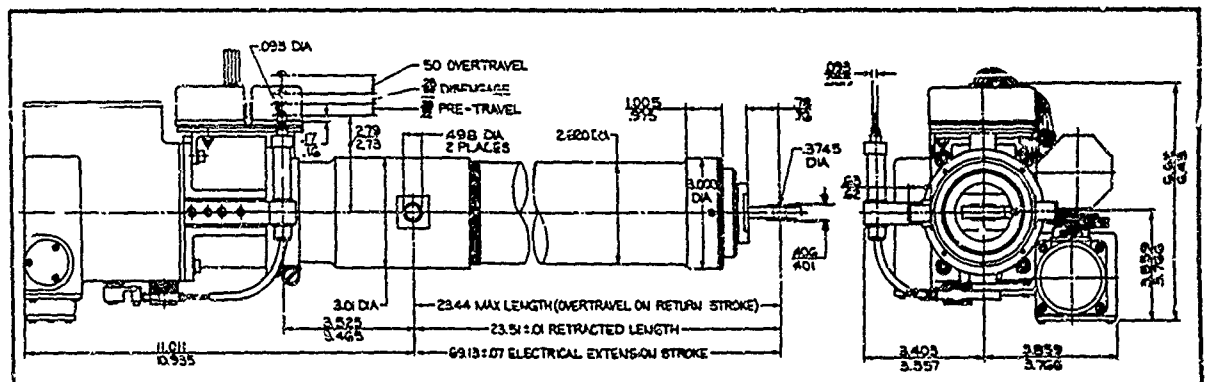
CROSS-SECTION DRAWING

Component

- A Housing, Bearing
- B Housing, Adapter
- C Pin, Spring
- D Speed Control Box Assembly
- E Actuator Assembly
- F Gear Box Assembly
- G Bracket, Clutch Release Cable
- H Tube, Ballistic

Component

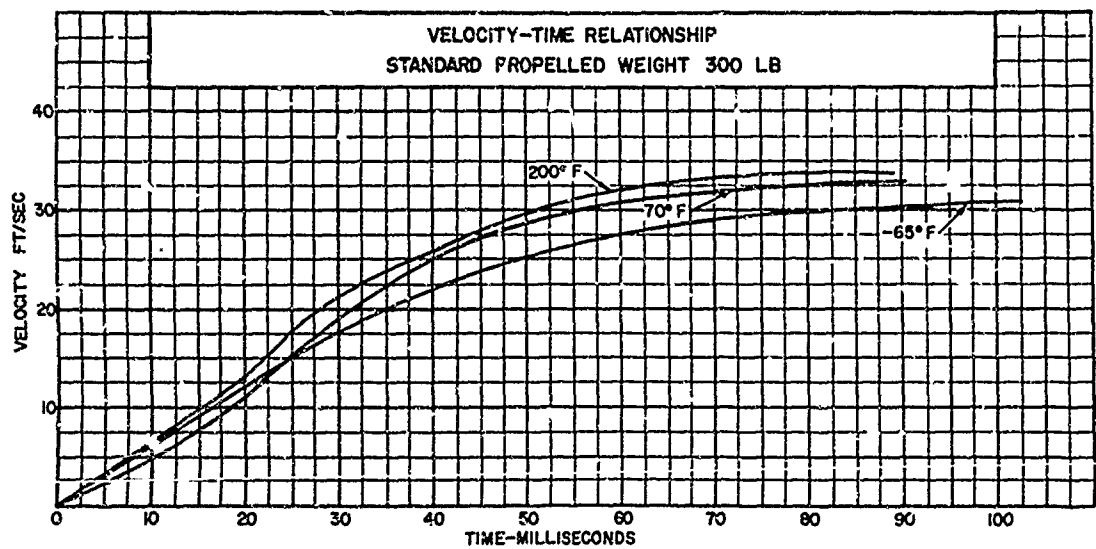
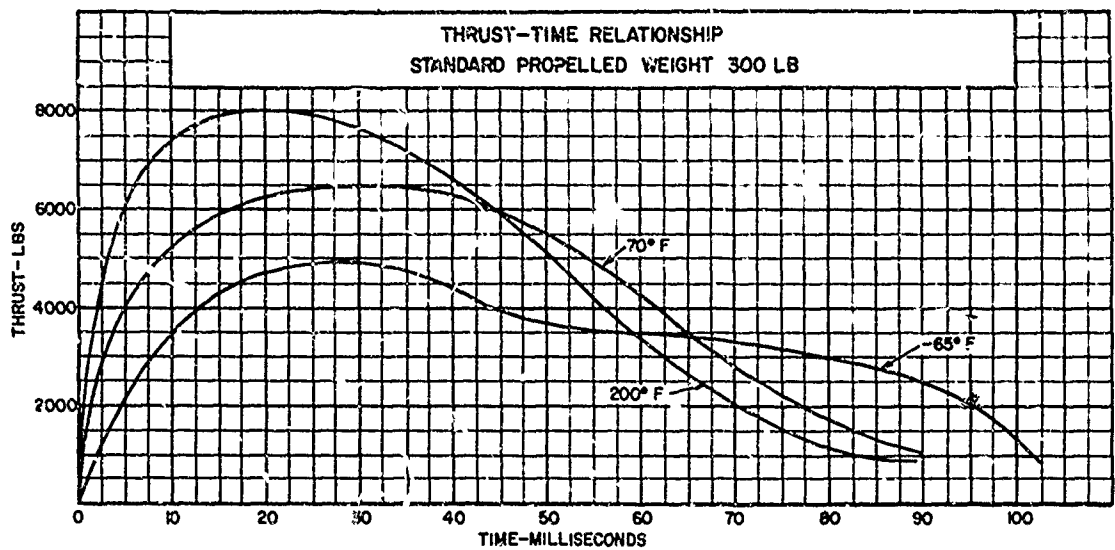
- I Plug, Shipping
- J Pin, Firing
- K Cap, Ballistic Chamber
- L Tube, Trunnion
- M Motor
- N Cartridge, Aircraft Canopy Remover, M151

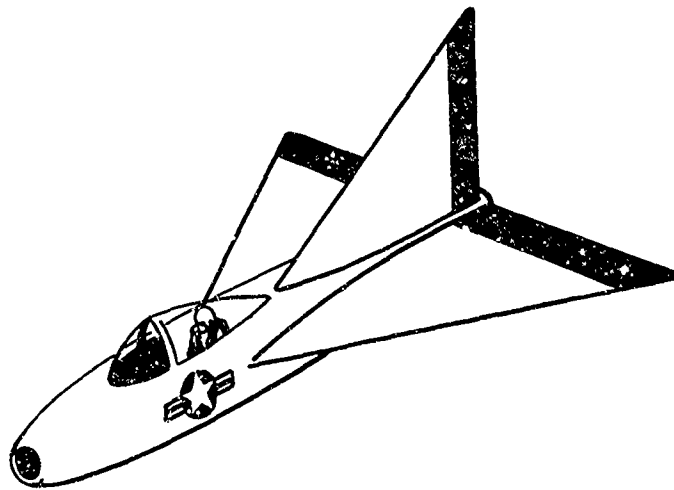


ENVELOPE DRAWING

Propellant Actuated Devices

Remover, Aircraft Canopy, M9





SECTION II

THRUSTERS

Thrusters

INTRODUCTION

Description:

A thruster is a component part of an aircraft escape system, which is used to accomplish a certain task prior to implementing the final phases of escape procedure, for crewman from a disabled aircraft. The basic parts of a thruster consist of a gas operated firing mechanism, cartridge, chamber and a piston. The main purpose of a thruster is to impart a thrust to a known load or oppose a force through a given travel (stroke).

Each thruster is provided with an initial lock mechanism for the piston. This mechanism is released only when the cartridge functions. Thrusters have been developed with piston strokes between 1-1/2 and 13 inches. Unlike corresponding parts of catapults and removers, the thruster piston does not separate from the thruster at the end of the piston stroke. Thus the thruster is a closed system.

Buffer or damper mechanisms are used in conjunction with thrusters to restrict the velocity and acceleration of the propelled load because of limitations on aircraft structure and human physiology. The rate of application of thrust and maximum thrust are specified when a thruster is used to position a crewman.

Operation:

All thrusters are triggered by gas pressure supplied from another cartridge actuated device. The firing pin of the thruster is held in position with a "shear pin". When gas pressure is supplied, the force applied on the firing pin will shear the "shear pin" and propel the firing pin against a cartridge containing a percussion-sensitive primer. The primer ignites the black powder and propellant contained in the cartridge. The cartridge ruptures at the unsupported area, and propellant gas fills the thruster chamber and exerts a force on the face of the piston. The initial piston motion unlocks the thruster and a force is applied through the piston to the load, setting it in motion. In some thrusters, there is a final lock to hold the piston in the extended position.

Propellant Actuated Devices

Thrusters

M1A2 THRUSTER

The M1A2 Thruster was developed to either jettison a hatch or unlock a tail turret. In both applications, the thruster is required to complete a 2 inch stroke against a varying force. The opposing force distance is represented by several shear pins located with respect to initial piston position. The diameter of each pin was selected so that the shear force at a given distance is equal to the corresponding maximum opposing force in the above applications. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape, approximately 9-1/2 inches long and 1-13/16 inches in diameter. The piston is initially locked in the chamber with 4 keys and is capable of withstanding a tensile load of 2000 pounds, without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust	6900 lbs.
Completed Stroke	2 inches, min.
Average Stroke Time	0.009 seconds
Assembled Weight	3.2 lbs.
Propelled Mass, Horizontal	20 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +160°F
Restraining Force	1000 lbs. @ .00 in. stroke; 6000 lbs. @ .25 in. stroke
Force Required to Unlock Initial Lock	60 lbs.
Actuation Force	750 psi, min.

Thruster, Cartridge Actuated, M1A2



68-.01
ACROSS FLATS

.627 D ± .030

1.265 D ± .030

1.4127 D ± .030

2.640 ± .030

1.827 D ± .030

1.375 ± .010
ACROSS FLAT

2.043 ± .062
EING DIA

1.40 D ± .01

1.140 ± .014

1.114 ± .03
ACROSS FLATS

1.359 D ± .030

5/16-18 NF-3

8.430 ± .047

5.662 ± .022

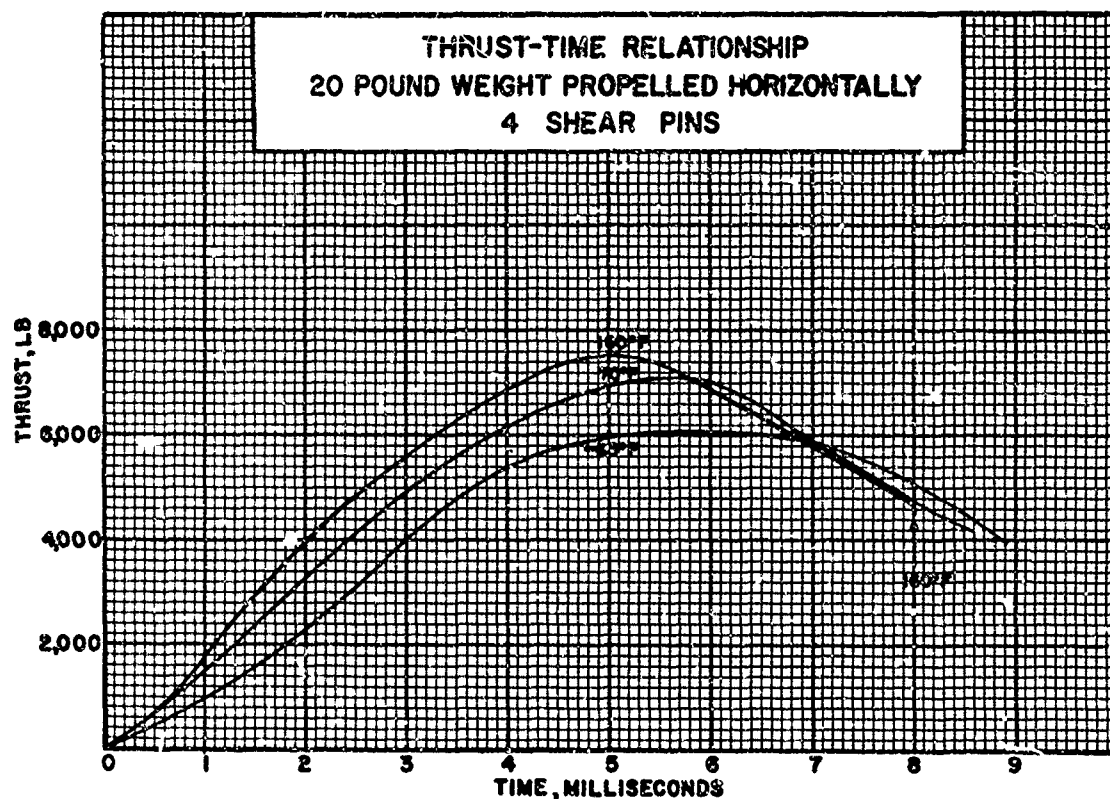
.375 D ± .002

1/16

ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M1A2



Thrusters

M2A2 THRUSTER

The M2A2 Thruster is a component part of an aircraft escape system whose purpose is to position the seat in an aircraft prior to ejection of the crewman. This device was designed to be used with a damper supplied by the airframe manufacturer. The thruster is required to complete a 5.7 inch stroke against an opposing force. The opposing force represents an approved ejection seat that must be moved either upward or downward with a velocity that does not exceed 12 feet per second.

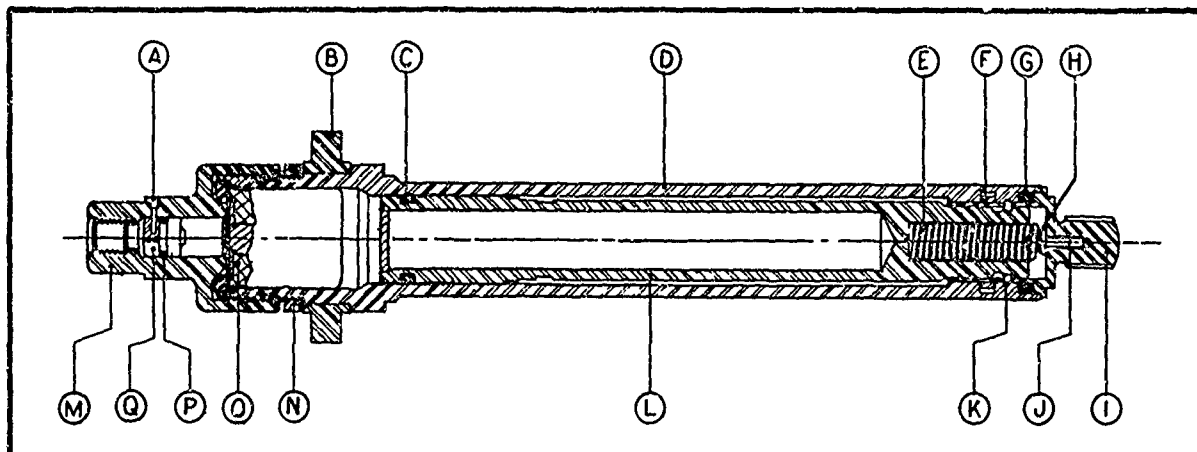
The thruster is cylindrical in shape, approximately 13.7 inches long and 1-7/8 inches in diameter. The piston is initially locked in the chamber with 4 keys and is capable of withstanding a tensile load of 2000 pounds without separation or mechanical failure. The thruster also has a final lock which holds the piston in the extended position and is capable of withstanding an 11,000 pound compressive load without unlocking.

The damper used with the M2A2 thruster is to control the acceleration of the propelled weight to limits consistent with human physiology limits and/or restrict the final velocity so that the impact does not damage the aircraft structure.

PRINCIPAL CHARACTERISTICS

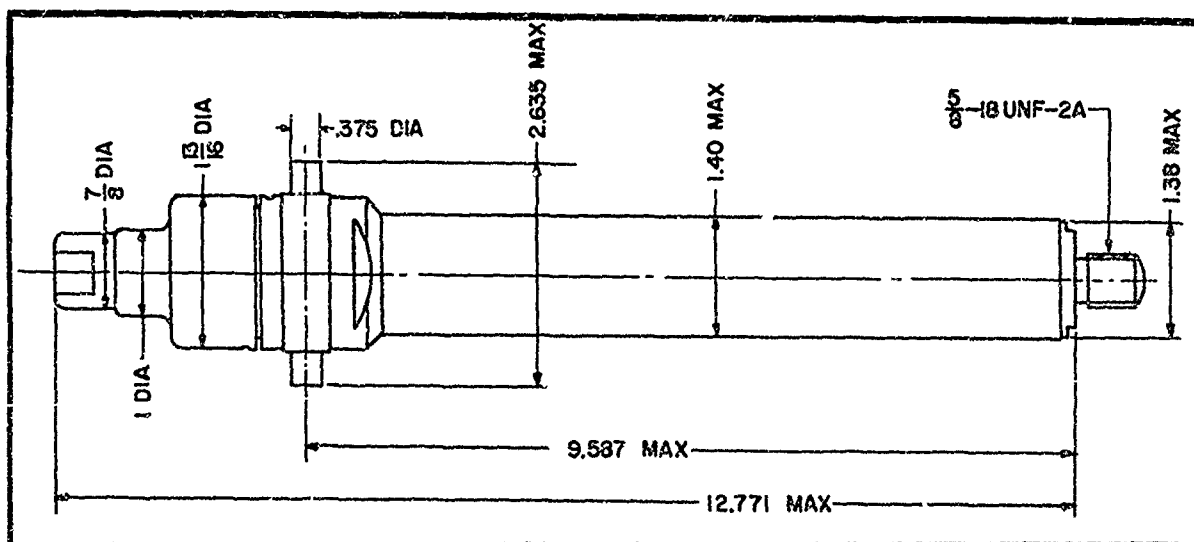
Average Peak Thrust w/Seat in Horizontal Position @ 70°F	6170 lbs.
Completed Stroke	5.7 inches
Velocity, Maximum	12 ft/sec
Assembled Weight	4.0 lbs.
Propelled Mass, Horizontal	300 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
Average Stroke Time w/Seat in Horizontal Position @ 70°F	.410 seconds
Force Required to Unlock Initial Lock	80 lbs
Actuation Force	750 psi, min.

Thruster, Cartridge Actuated, M2A2



CROSS-SECTION DRAWING

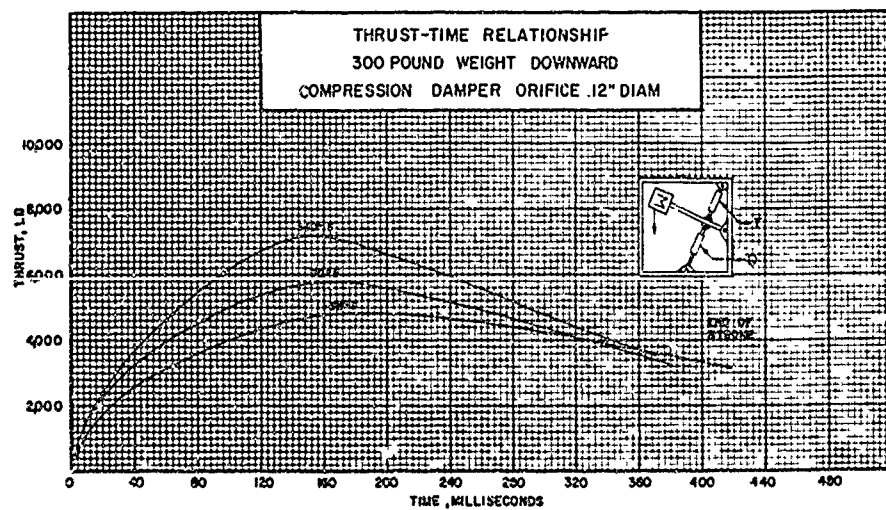
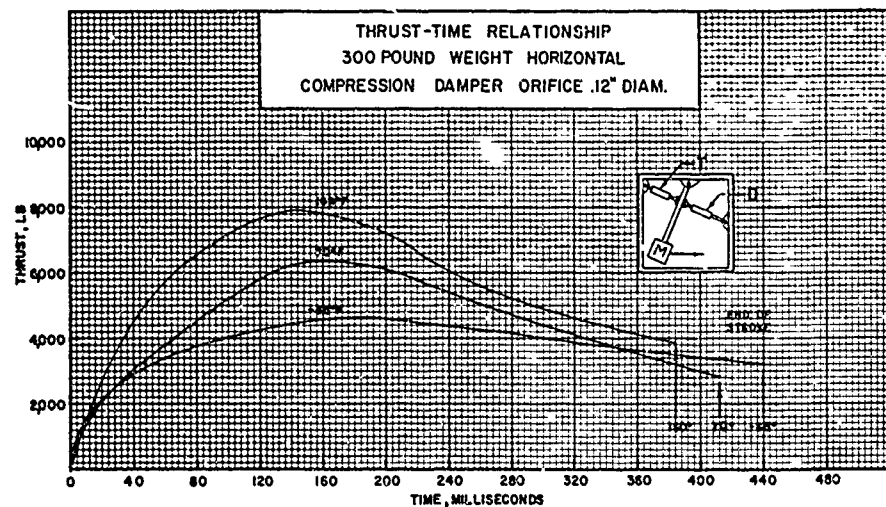
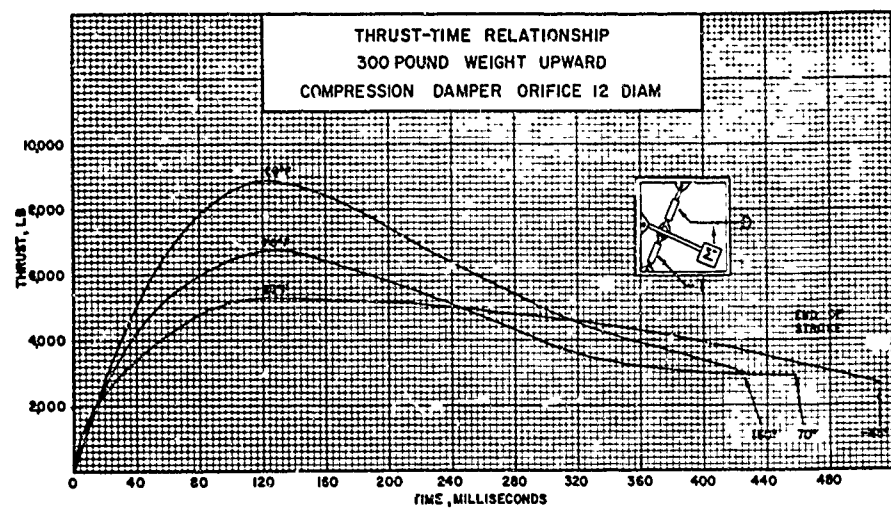
Component	Component
A Pin, Shear	J Screw, Cap, Socket Head
B Trunnion	K Key
C "O" Ring	L Piston And Plug Assembly
D Body	M Head
E Spring, Piston Locking	N Ring, Holding
F Ring, Snap	O Cartridge, CAD, M43
G "O" Ring	P "O" Ring
H Washer	Q Pin, Firing
I Sleeve, End	



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M2A2



Propellant Actuated Devices

Thrusters

M3A3 THRUSTER

The M3A3 Thruster is a component part of an aircraft escape system whose purpose is to release the control column stowage spring and supply sufficient energy to operate the seat actuator disconnect. The thruster is required to complete a 1-1/2 inch stroke against an opposing force and supply 600 psi pressure, minimum, at the end of a 4 foot length of hose. The opposing force is represented by a 550 pound load that must be propelled vertically with sufficient force so that the load continues to move after the piston reaches the end of its stroke. Thruster performance data using this test system is presented below.

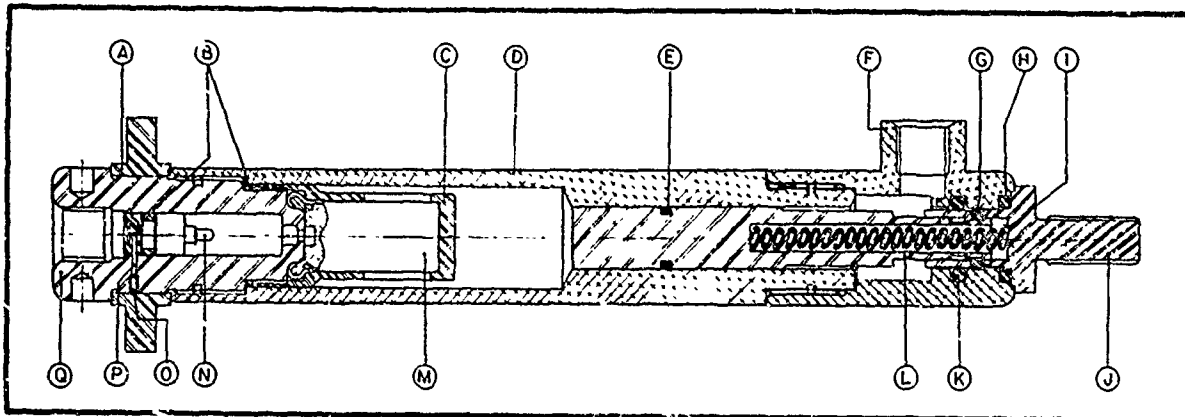
The thruster is cylindrical in shape, approximately 9 inches long and 1-5/64 inches in diameter. The piston is initially locked in the chamber with 3 keys and is capable of withstanding a tensile load of 800 pounds, without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust Under Normal Load @ 70°F	1660 lbs.
Completed Stroke	1-1/2 inches, min.
Assembled Weight	1.0 lb.
Propelled Mass, Vertical	550 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
By-Pass Pressure @ 70°F Under Normal Load at the End of 4 Ft Length of #4 Hose	600 psi, min.
Average Stroke Time	.090 seconds
Force Required to Unlock Initial Lock	20 lbs.
Actuation Force	750 psi, min.

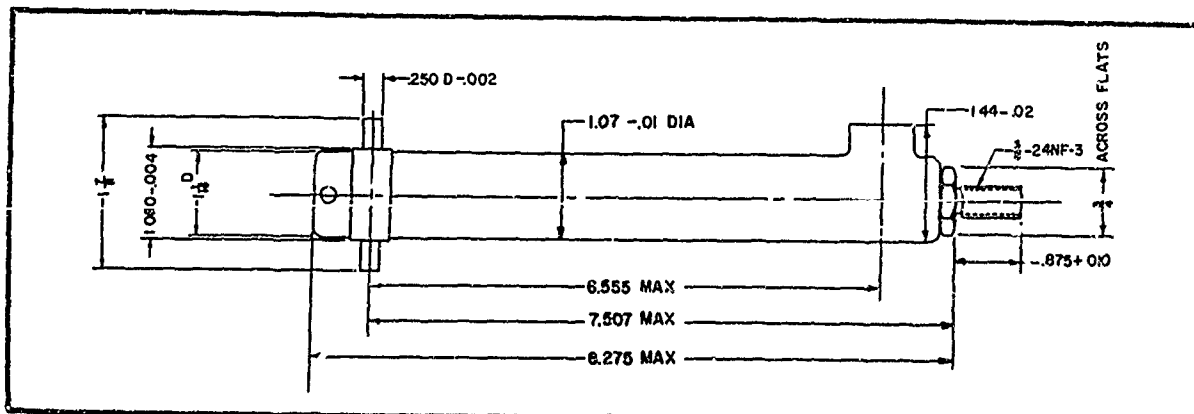
Propellant Actuated Devices

Thruster, Cartridge Actuated, M3A3



CROSS-SECTION DRAWING

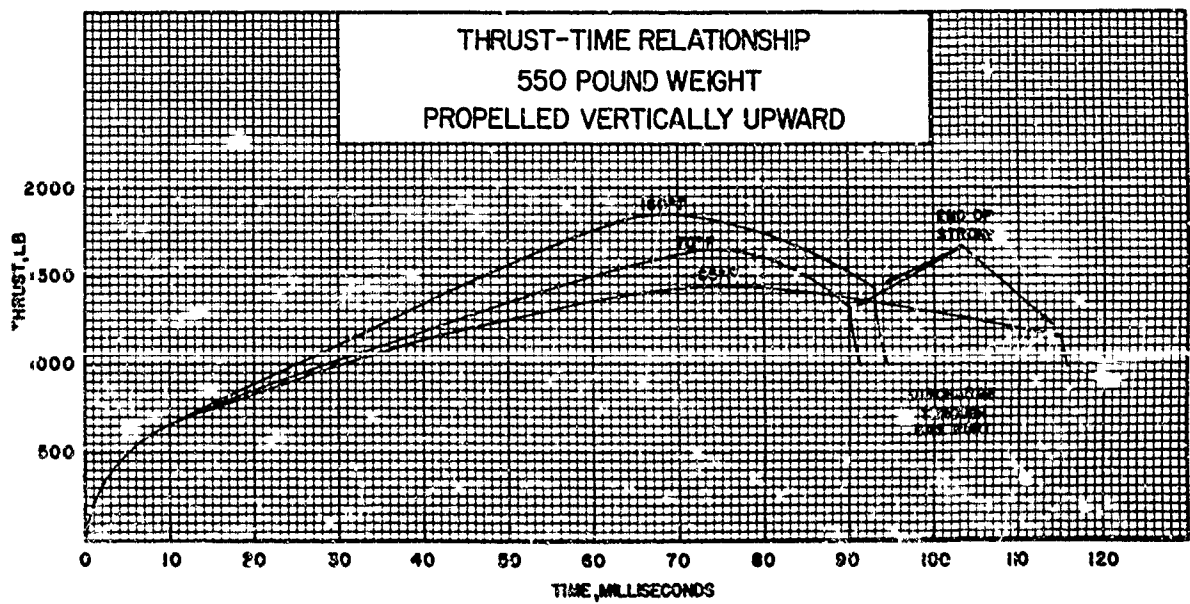
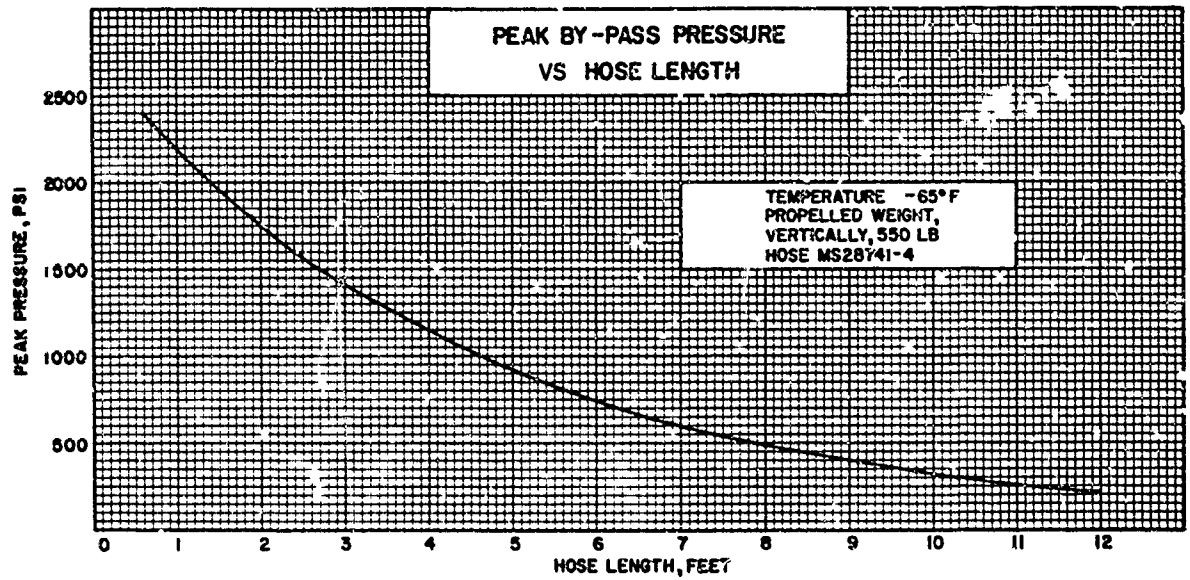
Component	Component
A Trunnion	J Sleeve, End
B "O" Ring	K "O" Ring
C Retainer, Cartridge	L Rod, Piston
D Body	M Cartridge, M44A1
E "O" Ring	N Pin, Firing
F Cap, End	O Screw, Set, Socket
G Key	P Pin, Shear
H "O" Ring	Q Breech
I Spring, Piston Locking	



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M3A3



Propellant Actuated Devices

Thrusters

M5A2 THRUSTER

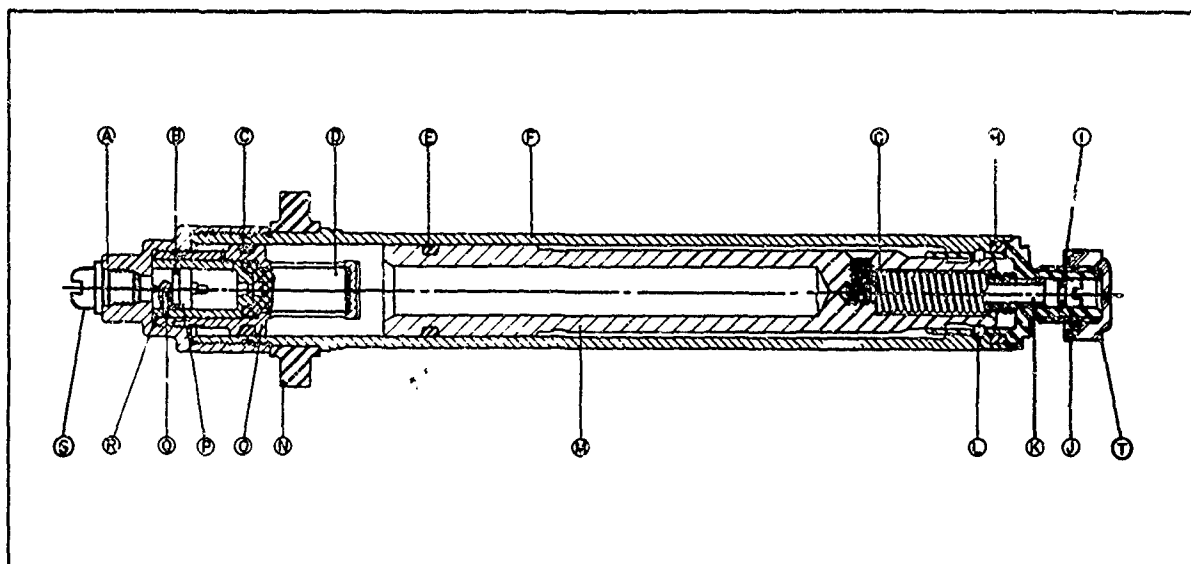
The M5A2 Thruster is a component part of an aircraft escape system whose purpose is to jettison the tail turret or to be used in various aircraft canopy release systems. The thruster is required to complete a 5 inch stroke against an opposing force. The opposing force is represented by a 500 pound carriage that must be propelled horizontally, after an initial restraining force of 4000 pounds is overcome. The initial restraining force is represented by a shear pin located at zero inches of stroke. Thruster performance data using this test system is presented below.

The thruster is cylindrical in shape approximately 12.6 inches long and 1.4 inch in diameter. The piston is initially locked in the chamber with 4 keys and is capable of withstanding a tensile load of 2000 pounds without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

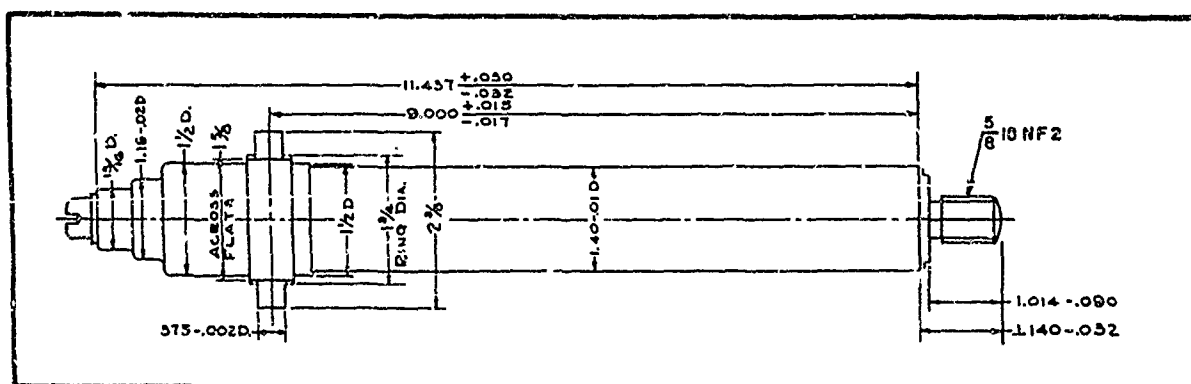
Average Peak Thrust Under Normal	
Load @ 70°F	6670 lbs.
Completed Stroke	5.0 inches
Average Stroke Time Under Normal	
Load @ 70°F	.075 seconds
Assembled Weight	3.6 lbs.
Propellant Mass, Horizontal	500 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
Restraining Forces	4000 lbs. @ .0 inches of stroke 1000 lbs. @ .5 inches of stroke
Actuation Force	750 psi, min.

Thruster, Cartridge Actuated, M5A2



CROSS-SECTION DRAWING

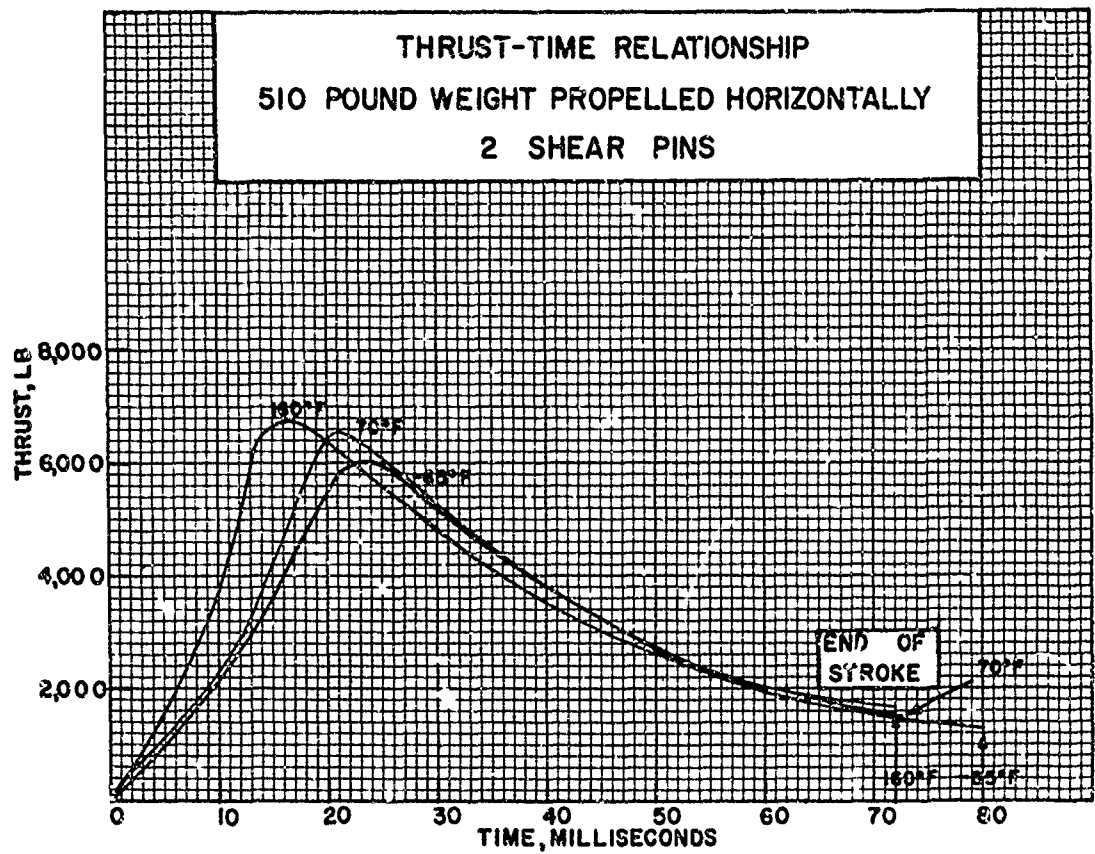
<u>Component</u>	<u>Component</u>
A Head	K Screw, Buffer
B "O" Ring	L Key
C "O" Ring	M Piston
D Cartridge, M73	N Trunnion
E "O" Ring	O Retainer, Cartridge
F Body	P Pin, Firing
G Spring, Piston Locking	Q Pin, Shear
H "O" Ring	R Guide, Firing Pin
I "O" Ring	S Plug, Shipping
J Sleeve, End	T Cap, Shipping



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M5A2



Propellant Actuated Devices

Thrusters

M6 THRUSTER

The M6 Thruster is a component part of an aircraft escape system whose purpose is to position the gun sighting equipment prior to implementing the escape procedure from the aircraft. The thruster is required to complete a 1-1/2 inch stroke against an opposing force. The opposing force is represented by a 60 pound weight that must be propelled horizontally, after an initial restraining force of 400 pounds is overcome. The initial restraining force is a shear pin located at zero inches of stroke.

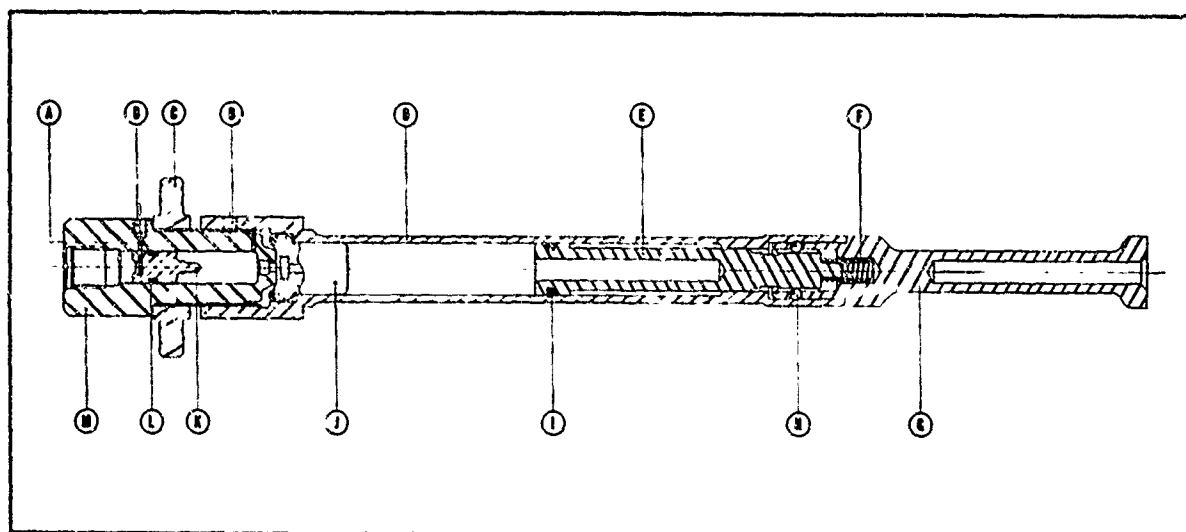
The thruster is cylindrical in shape, approximately 11.73 inches long and 1.07 inches in diameter. The piston is initially locked in the chamber with 3 balls and is capable of withstanding a tensile load of 250 pounds, without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust Under Load @ 70°F	1100 lbs.
Completed Stroke	1.5 in.
Assembled Weight	1.0 lbs.
Propelled Mass, Horizontal	60 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
Restraining Force	400 lbs.
Actuation Force	750 psi, min.

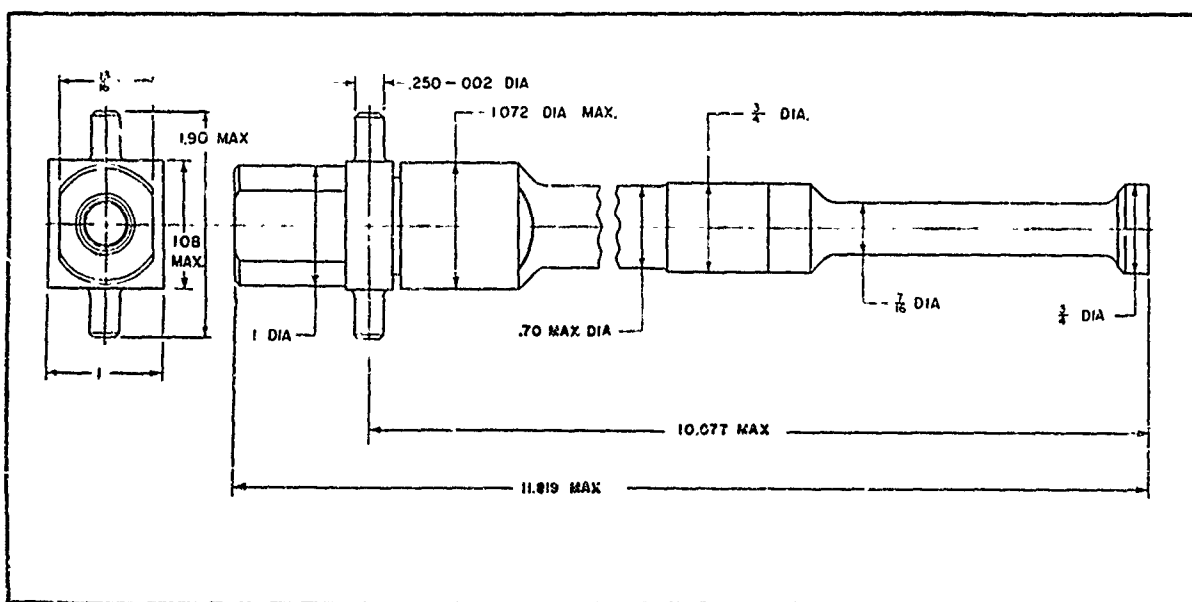
Propellant Actuated Devices

Thruster, Cartridge Actuated, M6



CROSS-SECTION DRAWING

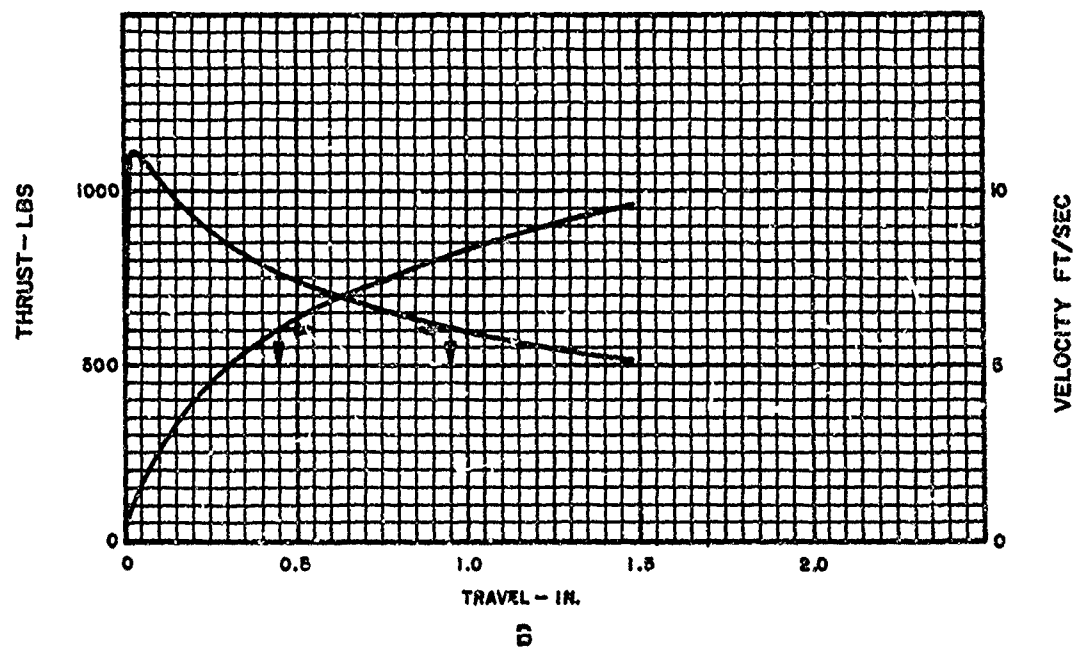
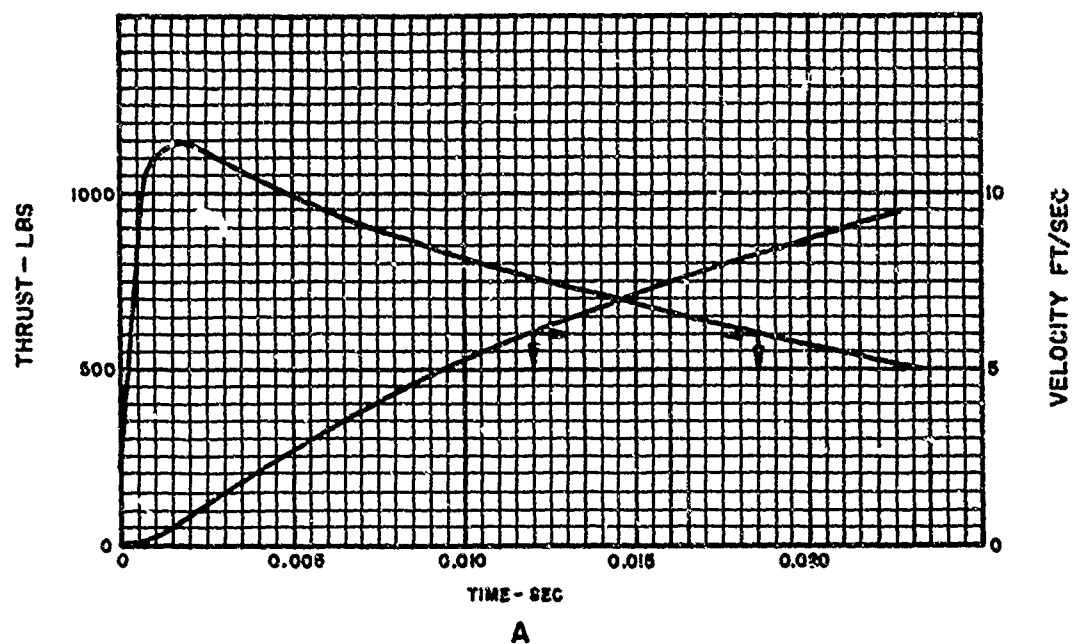
Component	Component
A Pin, Shear	H Ball
B Screw, Socket, Set	I "O" Ring
C Trunnion	J Cartridge, Thruster, M67
D Body	K Pin, Firing
E Piston	L "O" Ring
F Spring, Piston Locking	M Breech
G Sleeve, End	



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M6



A-TYPICAL PERFORMANCE-TIME CURVES
B-TYPICAL PERFORMANCE-TRAVEL CURVES

Propellant Actuated Devices

Thrusters

M7 THRUSTER

The M7 Thruster is a component part of an aircraft escape system whose purpose is to unlock and/or open a hatch. The thruster is required to complete a 2-1/2 inch stroke against an opposing force. The opposing force is represented by an 11.6 pound weight that must be propelled horizontally against constant 500 pound restraining force, which is simulated with an air cylinder.

The thruster is cylindrical in shape, approximately 10.2 inches long and 1.1 inches in diameter. The piston is initially locked in the chamber with 2 keys and is capable of withstanding a tensile load of 500 lbs., without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust Under Normal Load @ 70°F	1600 lbs.
Completed Stroke	2.5 inches
Average Stroke Time	.070 seconds
Assembled Weight	1.08 lbs.
Propelled Mass, Horizontal	11.6 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
Restraining Force	500 lbs.
Actuation Force	750 psi, min.

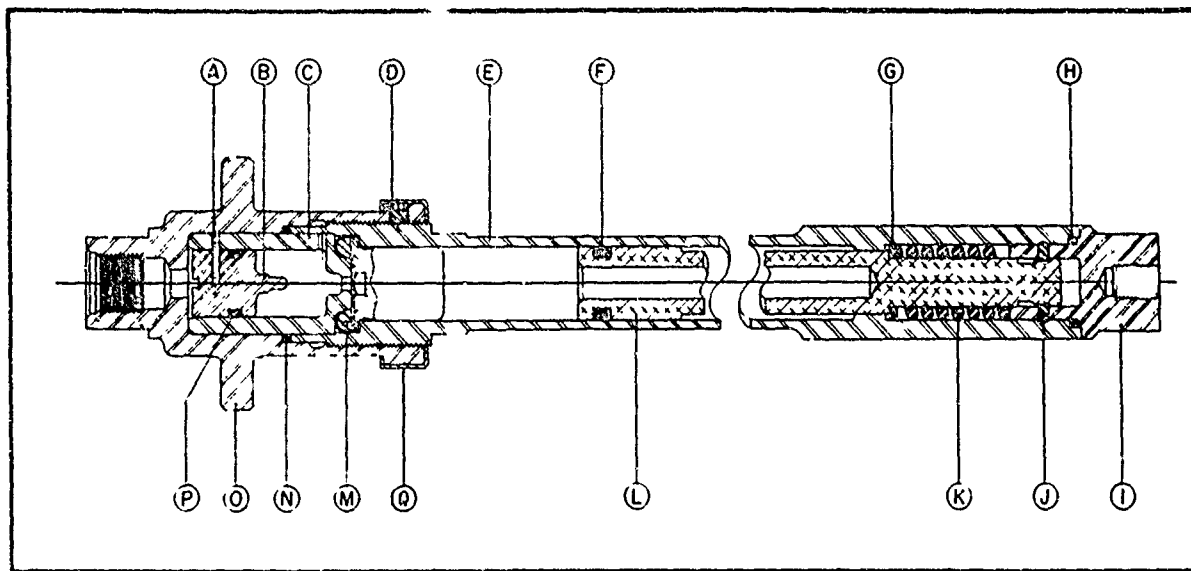


<u>Component</u>	<u>Component</u>
A Pin, Shear	J Key
B Pin, Firing	K Spring, Piston Locking
C Guide	L Piston
D Screw, Set	M Cartridge, Thruster, M67
E Body	N "O" Ring
F Gasket, "O" Ring	O Head
G Collar	P Gasket, "O" Ring
H "O" Ring	Q Seal
I Sleeve, End	



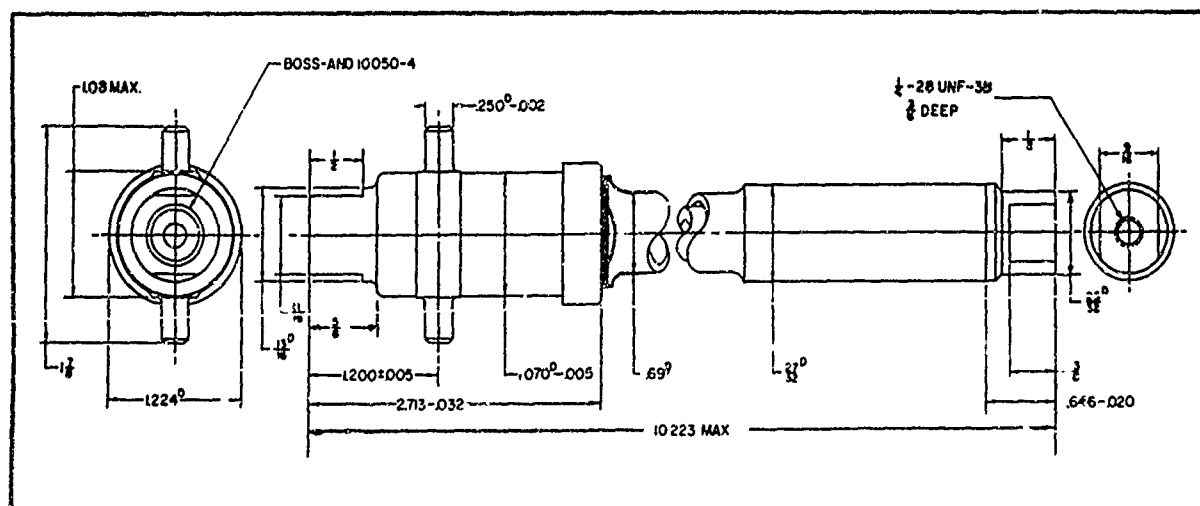
Propellant Actuated Devices

Thruster, Cartridge Actuated, M7



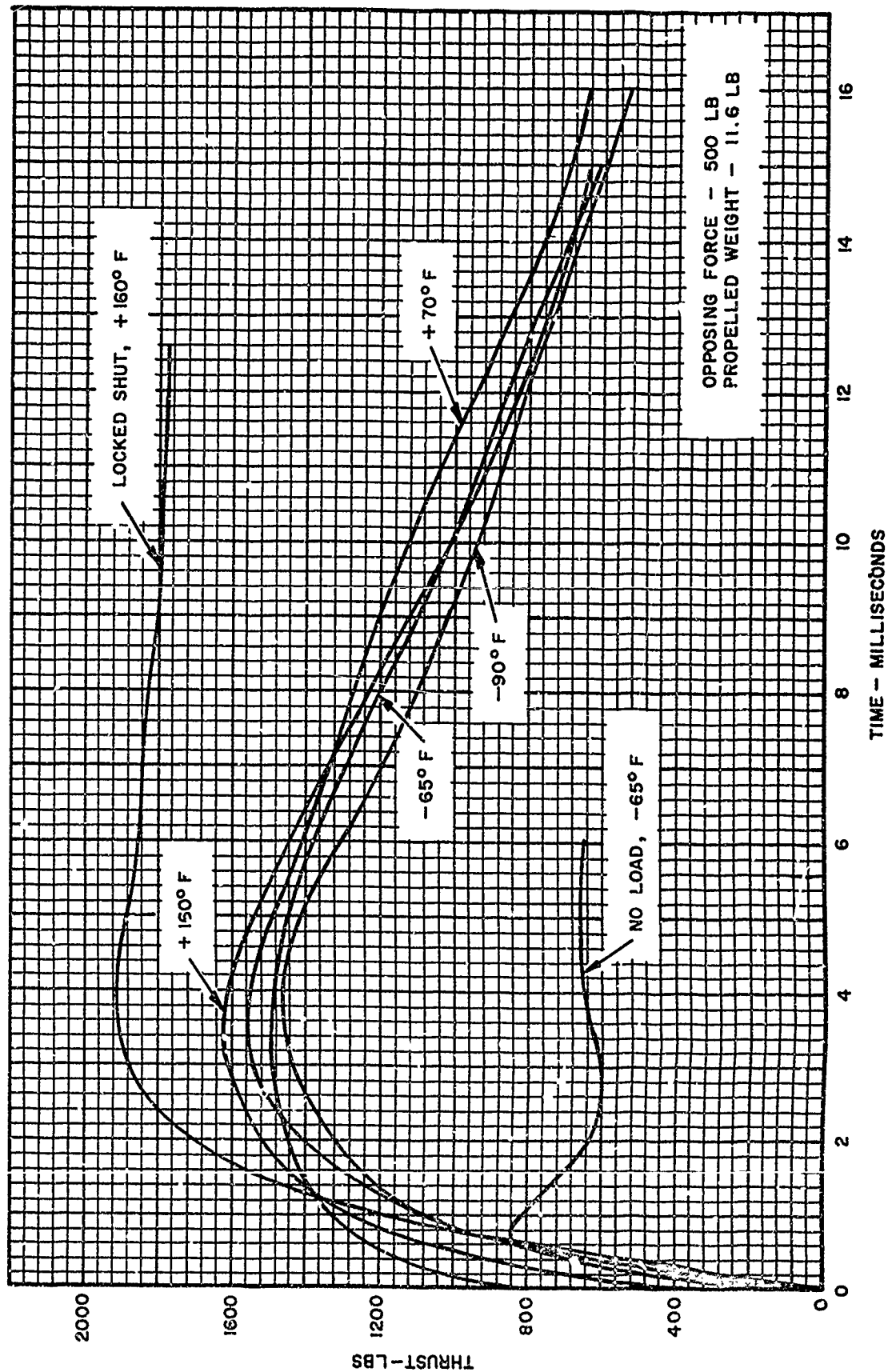
CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	J Key
B Pin, Firing	K Spring, Piston Locking
C Guide	L Piston
D Screw, Set	M Cartridge, Thruster, M67
E Body	N "O" Ring
F Gasket, "O" Ring	O Head
G Collar	P Gasket, "O" Ring
H "O" Ring	Q Seal
I Sleeve, End	



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M7



Thrusters

M9 THRUSTER

The M9 Thruster is a component part of an aircraft escape system whose purpose is to unlatch the canopy of an aircraft prior to implementing the escape procedures of aircraft personnel from the aircraft. The thruster is required to complete a stroke of 3.6 inches against a constant resistive force and supply a 1000 psi minimum pressure at the end of a 42 inch length of hose upon completion of its stroke. The force is represented by 50 pounds mass which is propelled against a 500 pound resistive force. Thruster performance data using this test system is presented below.

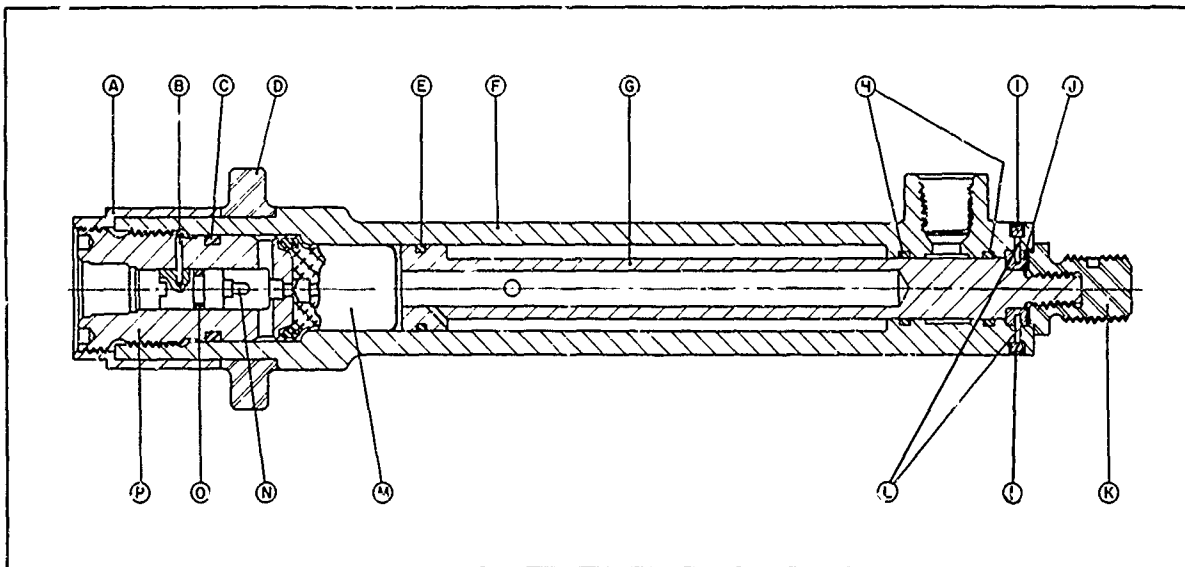
The thruster is cylindrical in shape, approximately 9.1 inches long and 1.4 inches in diameter. The piston is initially locked in the chamber with two "shear pins" and will unlock upon the application of a tensile load of 96 \pm 10 pounds.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust Under Load @ 70°F	2600 lbs.
Completed Stroke	3.6 inches minimum
Operating Time	.080 seconds
Assembled Weight	1.0 lbs.
Propelled Mass, Horizontal	50 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Resisting Force	500 lbs.
By-Pass Pressure Under Normal Load at the End of 42 Inch Length of #4 Hose	1000 psi
Actuation Force	750 psi, min.

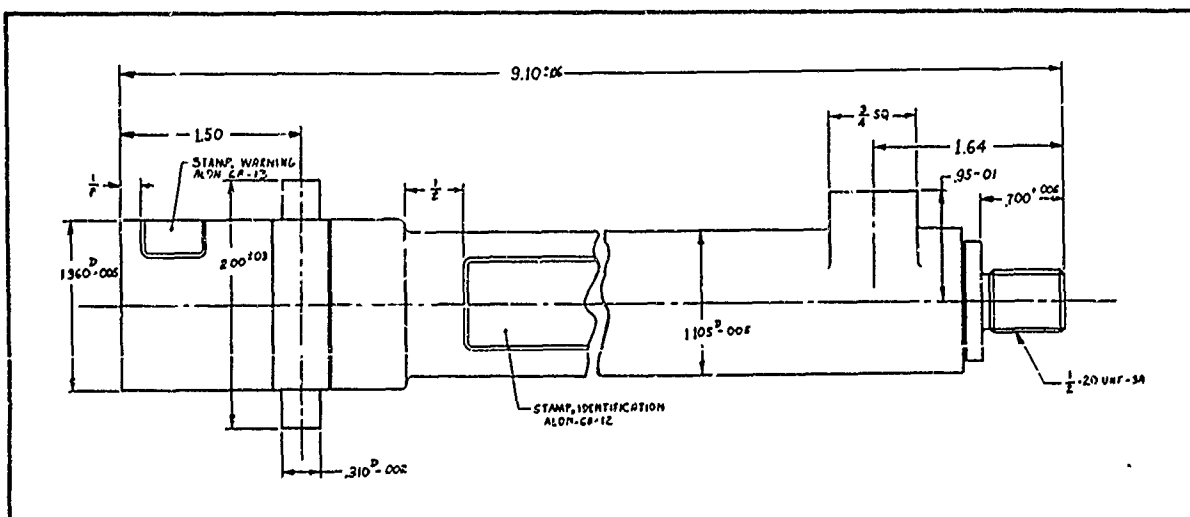
Propellant Actuated Devices

Thruster, Cartridge Actuated, M9



CROSS-SECTION, DRAWING

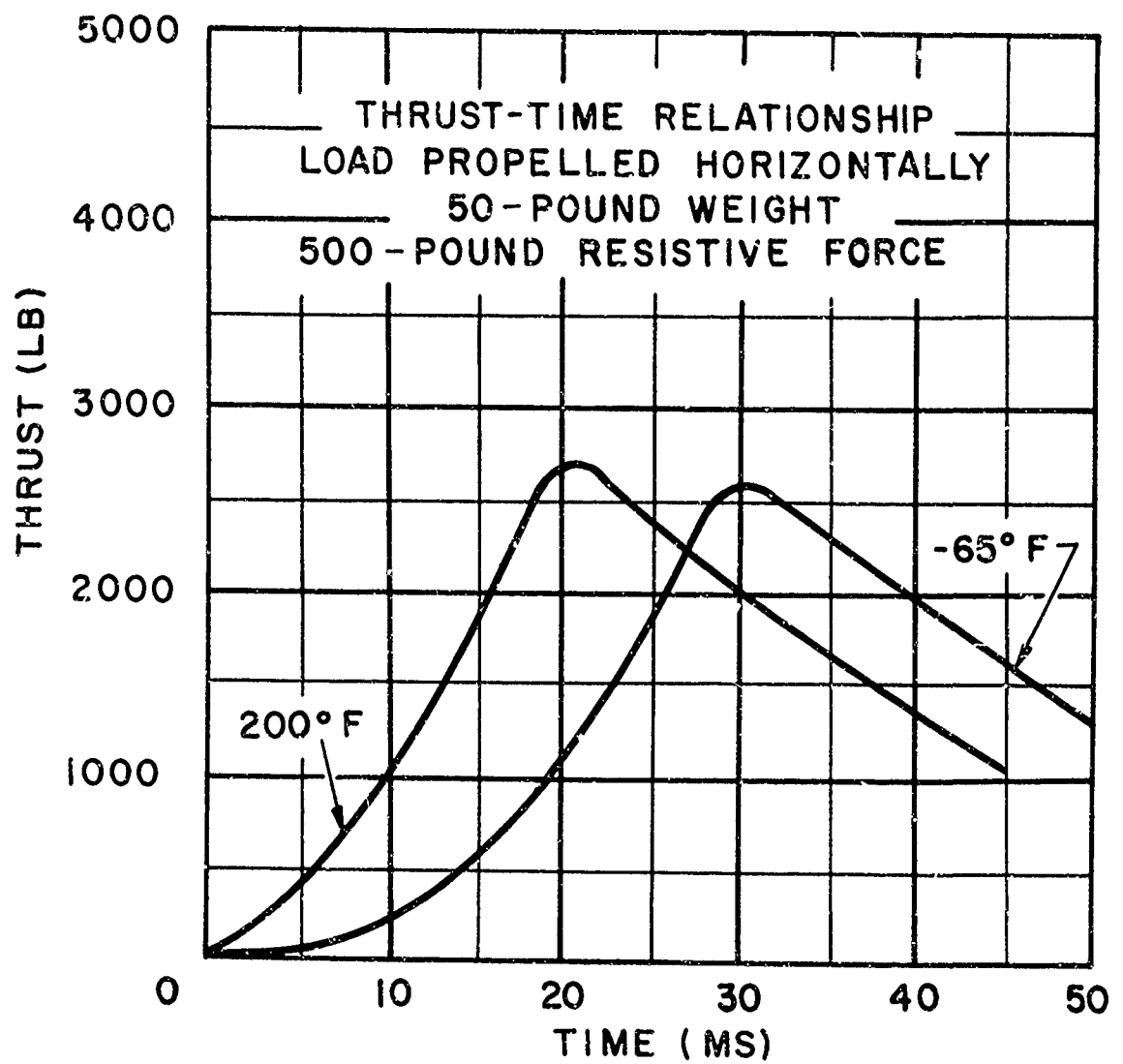
Component	Component
A Collar	I Screw, Set (2)
B Pin, Shear, Firing Pin	J Ring
C "O" Ring	K Adapter and Pellet Assembly
D Trunnion	L Pin, Shear, Piston (2)
E "O" Ring	M Cartridge, Thruster, M119
F Body	N Pin, Firing
G Piston	O "O" Ring
H "O" Ring (2)	P Breech



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M9



Propellant Actuated Devices

Thrusters

M11 THRUSTER

The M11 Thruster is a component part of an aircraft escape system whose purpose is to jettison the canopy of an aircraft prior to implementing the escape procedures of aircraft personnel from the aircraft. The thruster is required to complete a stroke of 5-3/4 inches and propel a simulated canopy through an arc of 90 degrees at a rate of 5 radians per second. The simulated canopy is represented by a 35 inch beam weighing 45 pounds. Thruster performance data using this test system is presented below.

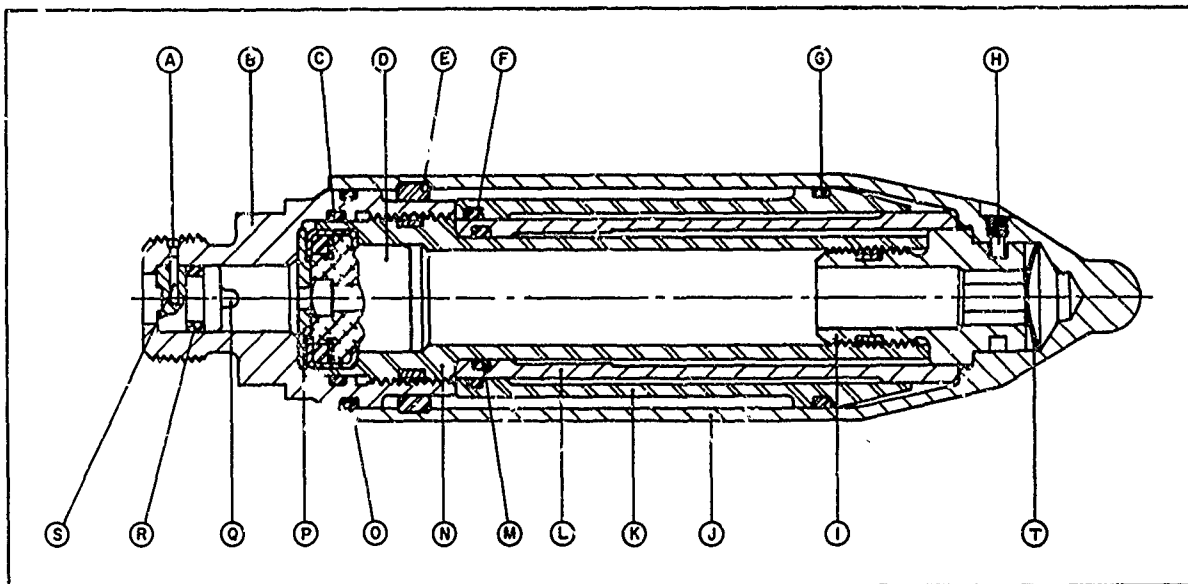
The thruster is cylindrical in shape, approximately 5.3 inches long and 1.25 inches in diameter. This thruster differs from the ordinary thrusters because it has three telescoping tubes in lieu of a moving piston. The tubes are initially locked with a shear screw, which will unlock upon the application of a tensile load of 160 ± 20 pounds.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust Under Normal Load @ 70°F	2272 lbs.
Completed Stroke	5.75 inches
Assembled Weight	.95 lbs.
Propelled Mass, Radially	45 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Velocity of Propelled Mass, Min.	5 rad/sec
Actuation Force	750 psi, min.

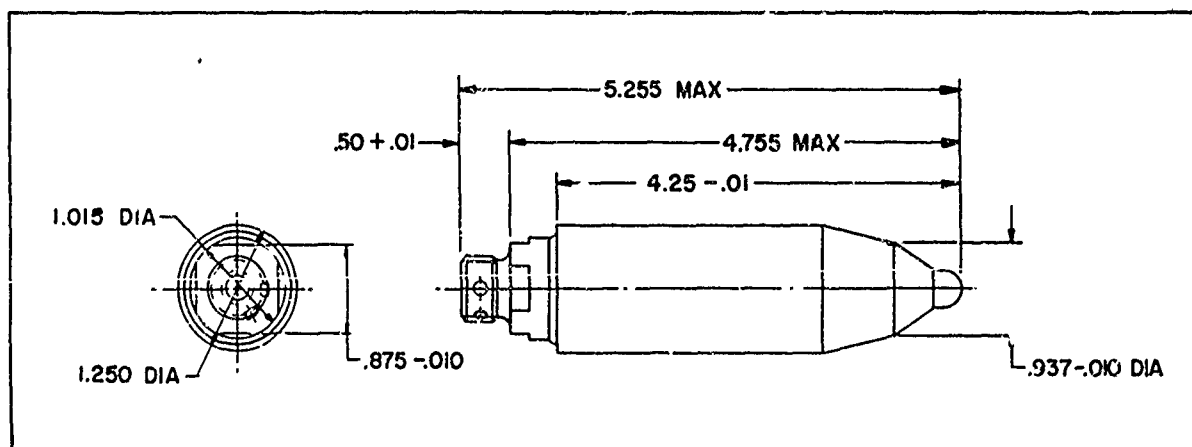
Propellant Actuated Devices

Thruster, Cartridge Actuated, M11



CROSS-SECTION DRAWING

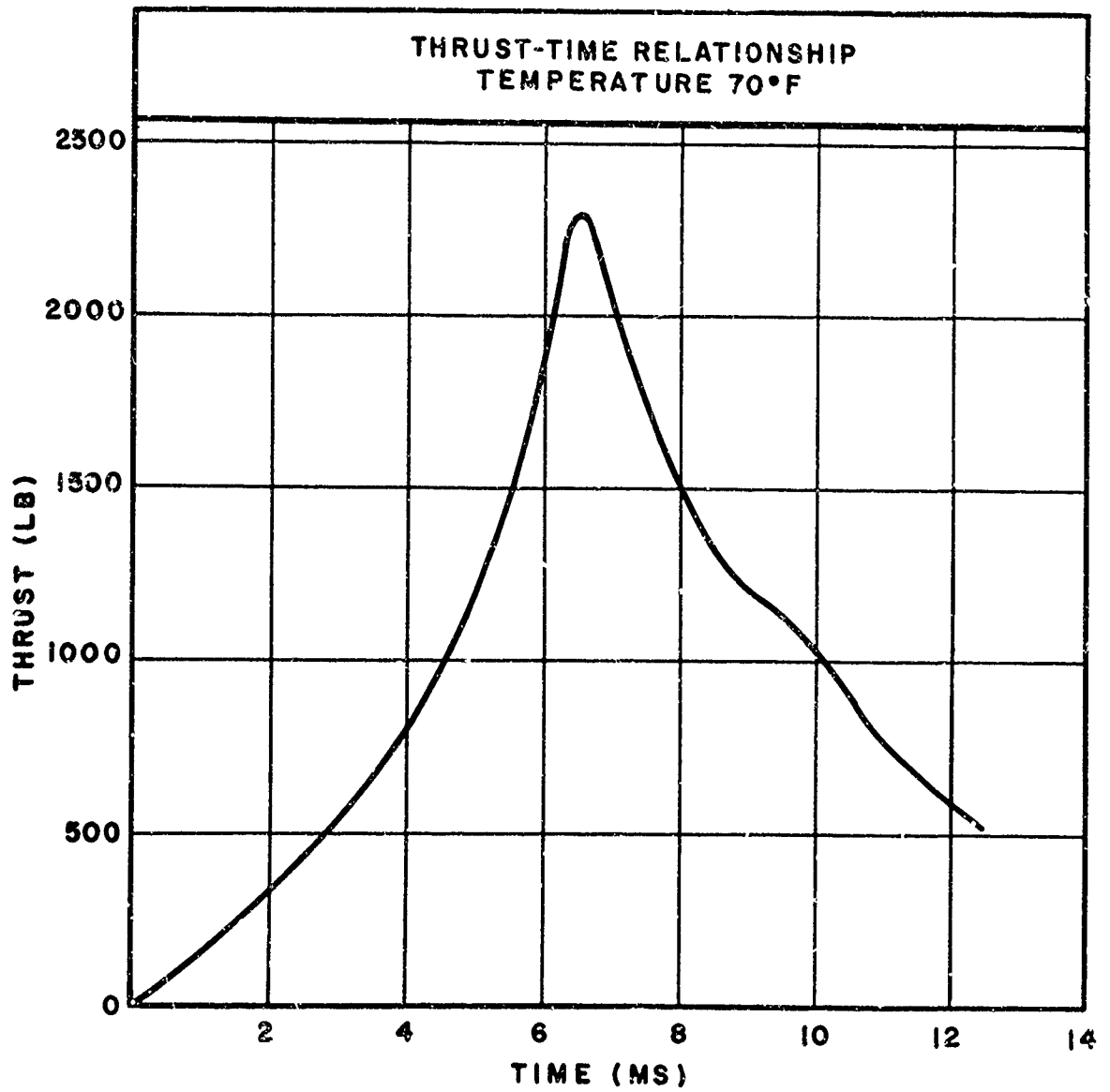
Component	Component
A Pellet	K Tube, Outside
B Head and Pellet Assembly	L Tube, Inside
C "O" Ring	M "O" Ring
D Cartridge, Thruster, M141	N Retainer and Pellet Assembly
E Ring, Segment	O "O" Ring
F "O" Ring	P Guide
G "O" Ring	Q Pin, Firing
H Screw, Shear	R "O" Ring
I Stop and Pellet Assembly	S Pin, Shear
J Body	T Washer, Curved



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M11



Propelled Actuated Devices

Thrusters

M13 THRUSTER

The M13 Thruster is a component part of an aircraft escape system whose purpose is to unlock the canopy of an aircraft prior to ejection of the crewman. The thruster is required to complete a stroke of 2.76 inches against an opposing force and supply 1000 psi pressure, minimum, at the end of a 6 foot length of hose. The opposing forces are represented by a 70 pound weight which is propelled vertically after an initial restraining force of 2000 pounds is overcome. The initial restraining force is represented by a shear pin located at zero inches of stroke. Thruster performance data using this test system is presented below.

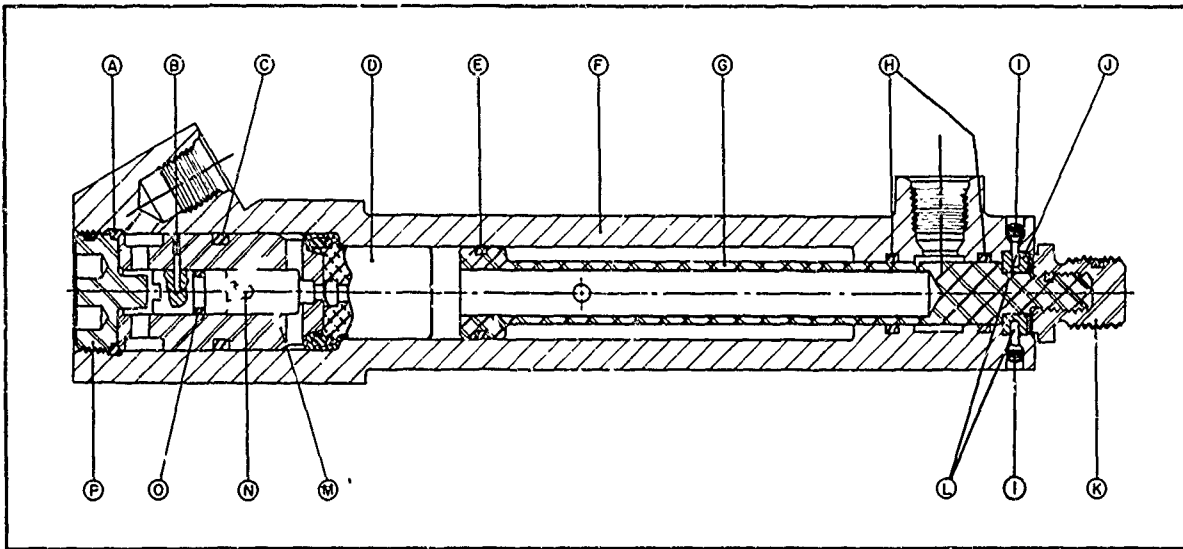
The thruster is cylindrical in shape, approximately 8.2 inches long and 1.2 inches in diameter. The piston is initially locked in the chamber with 2 shear pins and will unlock upon the application of a tensile load of 96 pounds.

PRINCIPAL CHARACTERISTICS

Thrust Under Load @ 70°F	2700 lbs.
Completed Stroke	2.86 inches, max.
Assembled Weight	1.07 lbs.
Propelled Mass, Vertical	70 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
By-Pass Pressure Under Load @ 6 Foot of #4 Hose	1000 lbs., min.
Restraining Force	2000 lbs. @ 0 inches of stroke
Operating Time	.080 seconds, max.
Actuation Force	750 psi, min.

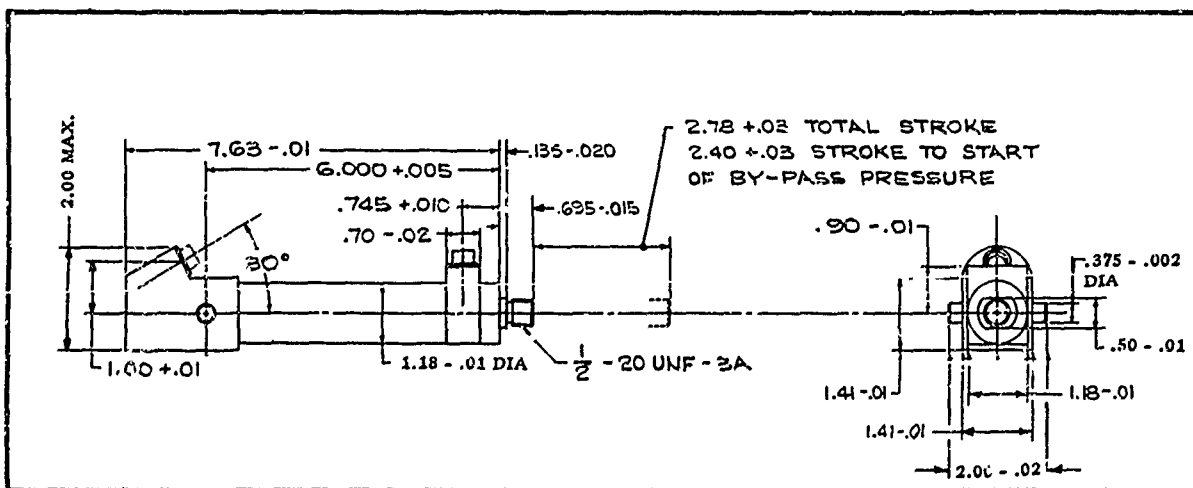
Propellant Actuated Devices

Thruster, Cartridge Actuated, M13



CROSS-SECTION DRAWING

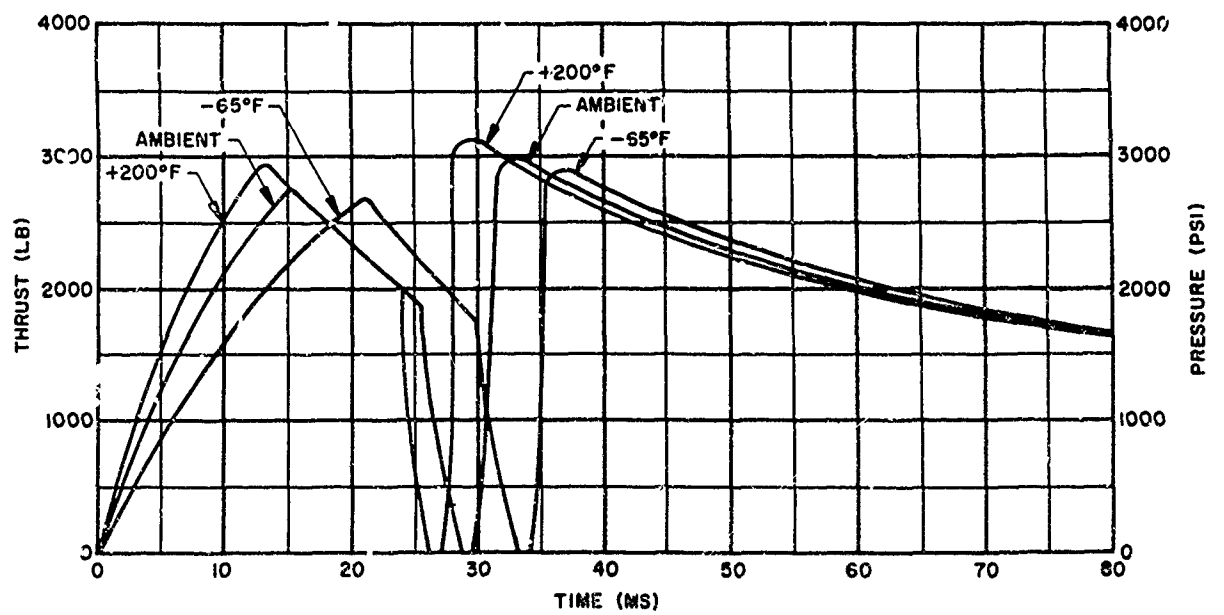
Component	Component
A "O" Ring	I Screw, Set (2)
B Pin, Shear, Firing Pin	J Ring, Shear
C "O" Ring	K Fastener, Piston and Pellet Assembly
D Cartridge, Thruster, M119	L Pin, Shear, Piston (2)
E "O" Ring	M Breech
F Body	N Pin, Firing
G Piston	O "O" Ring
H "O" Ring (2)	P Cap, Base and Pellet Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M13



Propellant Actuated Devices

Thrusters

M15 THRUSTER

The M15 Thruster is a component part of an aircraft escape system whose purpose is to position the crewman's feet and raise the leg guards of the ejection seat prior to ejection of the crewman. The thruster is required to complete a 4.42 inch stroke, with the piston being retracted into the cylinder, against an opposing force. The opposing force is represented by an 11 pound weight which must be propelled horizontally against a restraining force of 2250 pounds after an initial restraining force of 3750 pounds is overcome. Silicone oil is employed for internal damping to keep the acceleration of the propelled weight within limits consistent with human physiology. Thruster performance data using this test system is presented below.

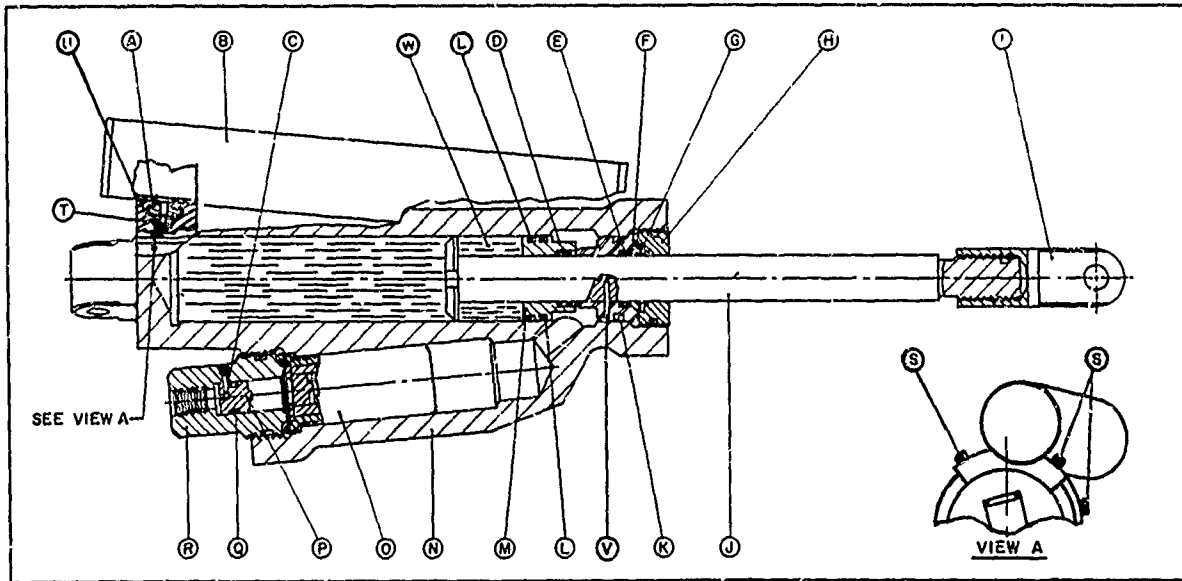
The thruster is irregular in shape, approximately 16-7/8 inches from the end of the extended piston to opposite mounting end of the body. An external reservoir is attached to the body for the accumulation of oil as it is metered from the body. The piston is initially locked in the body with a "shear pin" which will unlock upon the application of a compressive load of 1150 pounds. The thruster also has a final lock which holds the piston in the retracted position and is capable of withstanding a tensile load of 15,000 pounds without unlocking.

PRINCIPAL CHARACTERISTICS

Approximate Thrust	6700 psi
Completed Stroke	4.42 inches
Assembled Weight	5.0 lbs.
Resistive Force (shear pin)	3750 lbs.
Resistive Force (air load)	2250 pounds
Firing Method	Propellant Gas
Temperature Limits	-65°F to +165°F
Propelled Mass	11 lbs.
Operating Time @ -65°F	500 milliseconds, approximately
Actuation Force	750 psi, min.

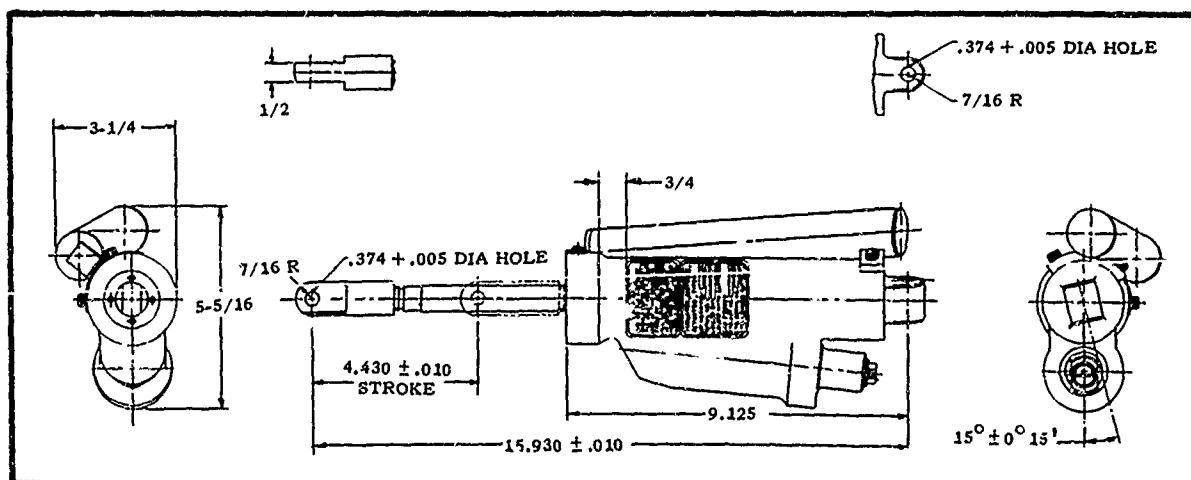
Propellant Actuated Devices

Thruster, Cartridge Actuated, M15



CROSS-SECTION DRAWING

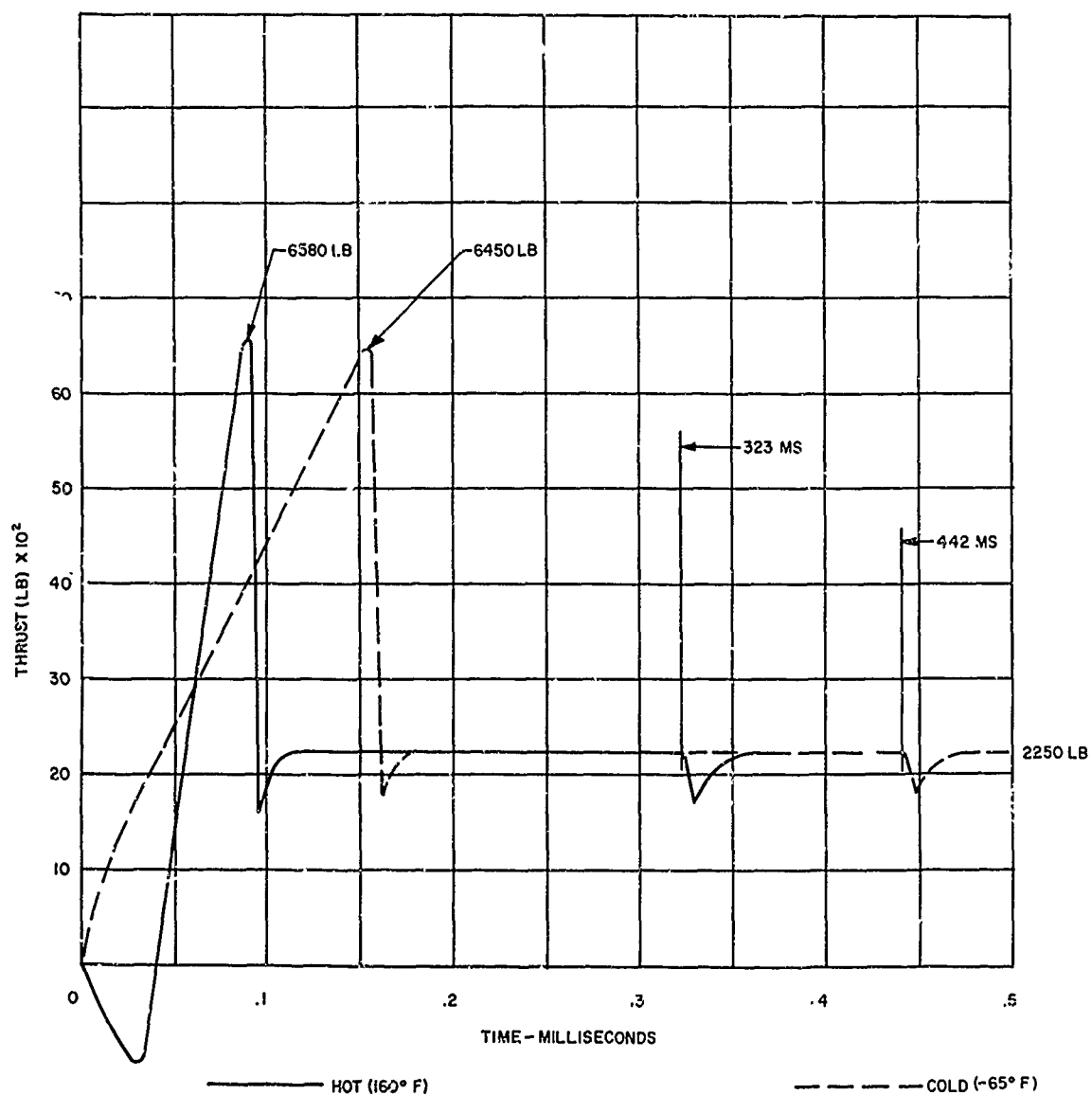
Component	Component
A Spacer	M Piston
B Body, Reservoir	N Body
C Pin, Shear, Firing Pin	O Cartridge, Thruster, M94
D Ring, Back-Up (4)	P Pin, Firing
E "O" Ring (2)	Q "O" Ring
F Spacer	R Housing, Firing Pin
G Ring, Retaining	S Screw, Cap, Socket Head (4)
H Nut, Ring And Pellet Assembly	T Screw, Hollow Lock Plug, Reservoir Gasket
I Rod, End	U "O" Ring
J Rod, Piston	V Pin, Unlock Shear
K "O" Ring	W Fluid, Silicone
L "O" Ring (2)	



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M15



Propellant Actuated Devices

Thrusters

M16 THRUSTER

The M16 Thruster is a component part of an aircraft escape system whose purpose is to position the crewman's legs prior to implementing the escape procedure from the aircraft. The thruster is required to complete a stroke of 3 inches, min, when fired against a resistive load simulating a dorsal stabilizing fin. Oil in the thruster cylinder acts as a damping medium to keep the stroke time within the design requirements.

The thruster is cylindrical in shape, approximately 9.9 inches long and 1.19 inches in diameter. The piston is initially locked by a "shear pin" and will unlock upon application of a tensile load of 130 ± 10 pounds.

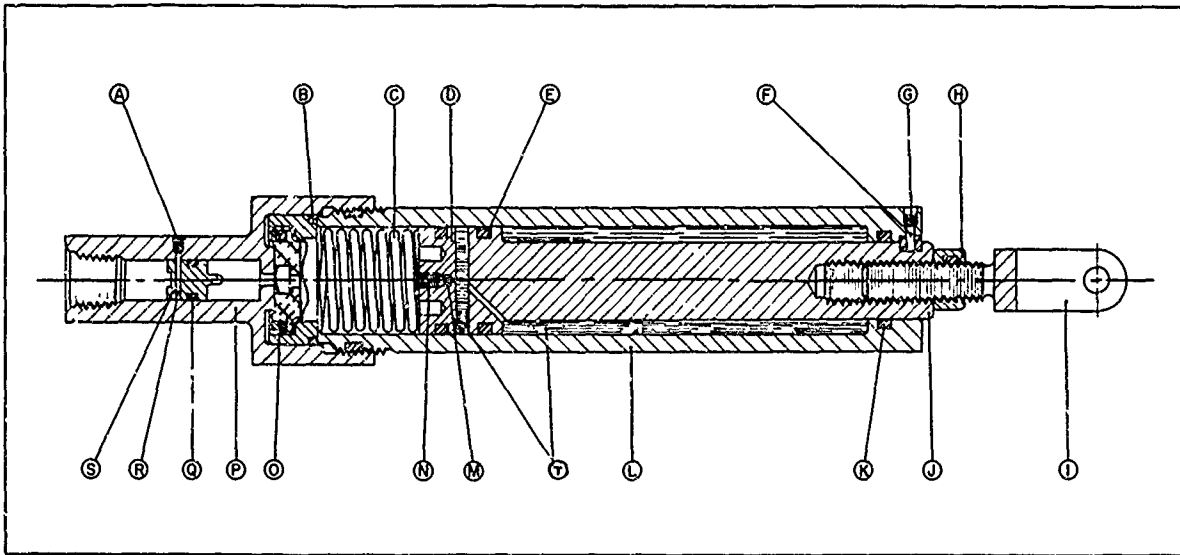
The oil damper is to control the acceleration of the propelled weight to limits consistent with human physiology limits and/or restrict the final velocity so that the impact does not damage the aircraft structure.

PRINCIPAL CHARACTERISTICS

Approximate Peak Thrust	200 lbs.
Completed Stroke	3.137 max.
Assembled Weight	1.6 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Operating Time	.070 sec. to .130 sec.
Actuation Force	750 psi, min.

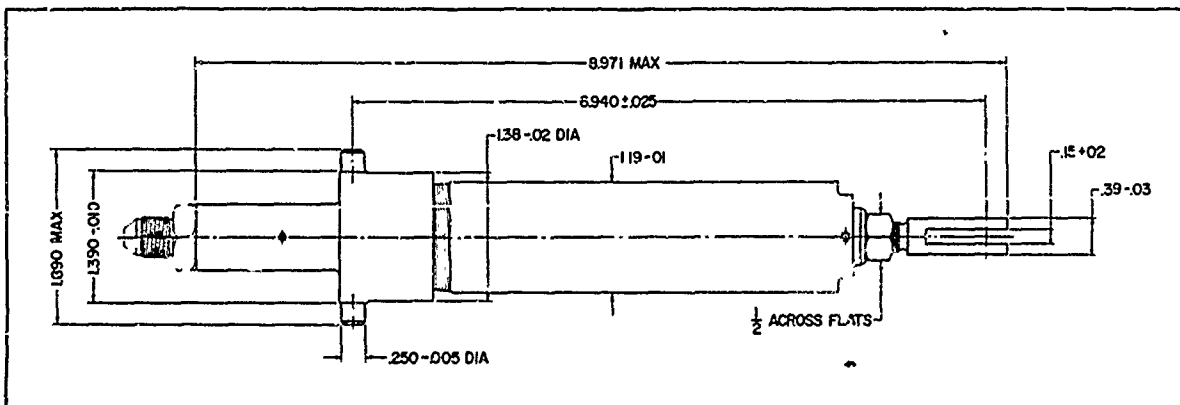
Propellant Actuated Devices

Thruster, Cartridge Actuated, M16



CROSS-SECTION DRAWING

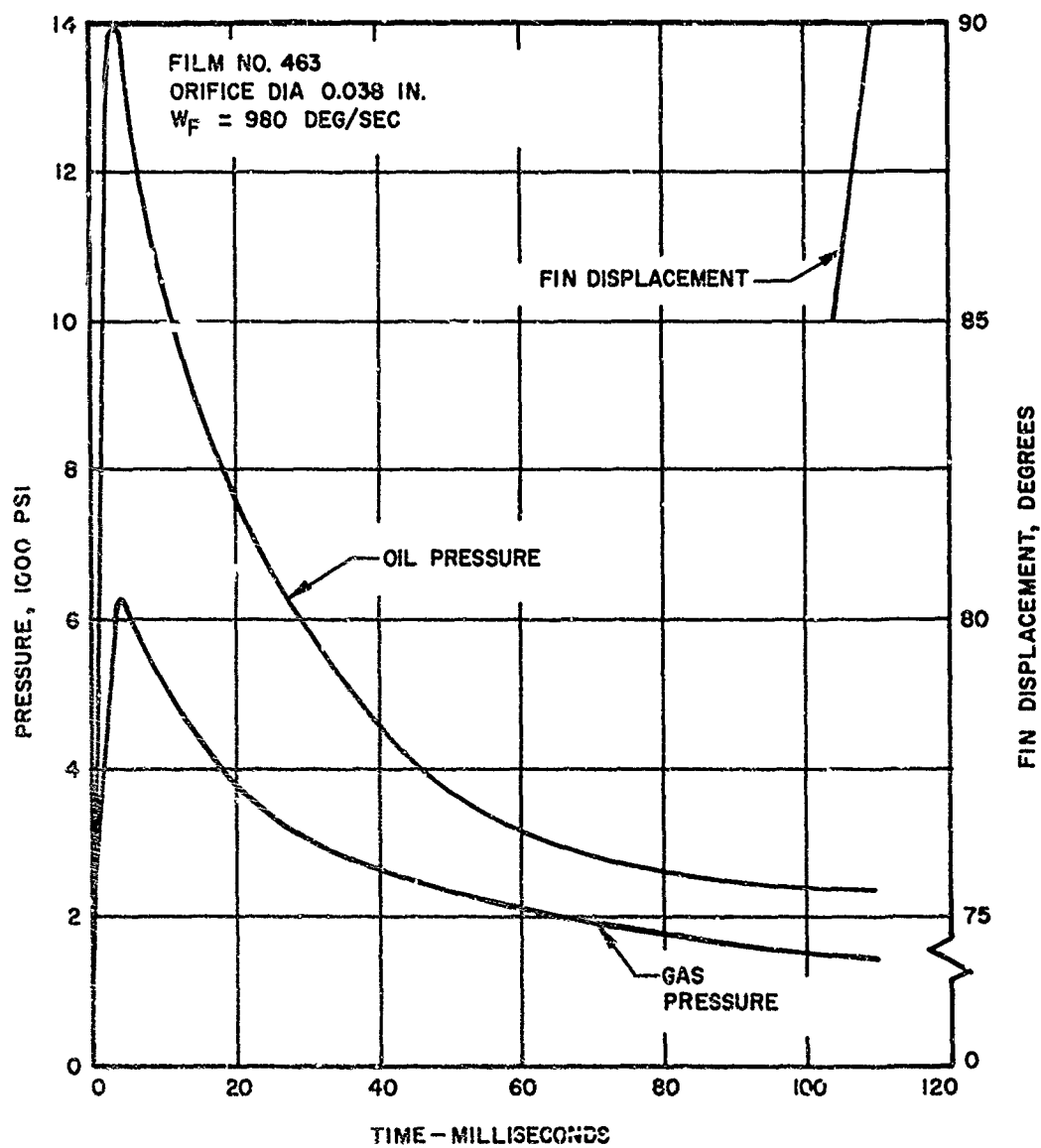
Component	Component
A Screw, Set	K Ring, Sealing
B Packing	L Cylinder and Pellet Assembly
C Spring	M "O" Ring
D Piston, Floating	N Screw, Set
E Ring, Sealing (2)	O Cartridge, Thruster, M146
F Pin, Locking	P Head
G Screw, Set	Q Packing
H Nut, Lock	R Pin, Shear
I Clevis	S Pin, Firing
J Piston	T Fluid, Silicone



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M16



Propellant Actuated Devices

Thrusters

M17 THRUSTER

The M17 Thruster is a component part of an aircraft escape system whose purpose is to position the seat in an aircraft prior to ejection of the crewman. The thruster is required to complete a 13-1/4 inch stroke against an opposing force. The opposing force is represented by a 350 pound mass that must be propelled against a force that increases from 0 to 525 pounds. The thruster uses oil for an internal damping medium to keep the acceleration of the propelled weight within limits consistent with human physiology.

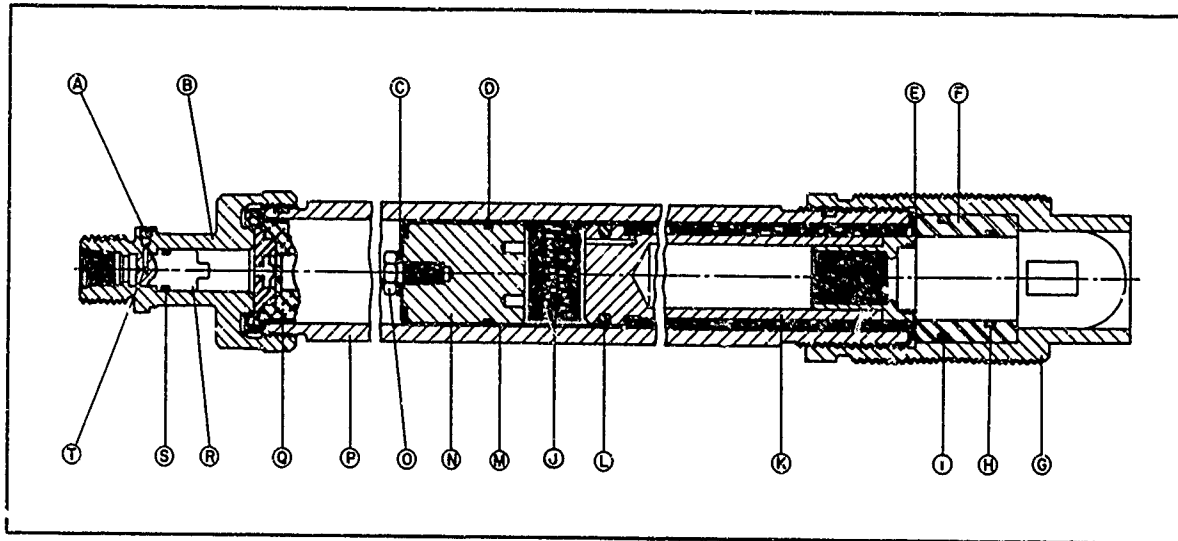
The thruster is cylindrical in shape, approximately 25.37 inches long and 1.82 inches in diameter. The piston is initially locked in the chamber with shear discs and will unlock upon application of a 700 pound tensile load.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust Under Load @ +165°F	1600 lbs.
Completed Stroke	13-1/4 inches
Max Piston Velocity	12 ft/sec
Assembled Weight	13.0 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +160°F
Propelled Mass, Horizontal	350 lbs.
Restraining Force	525 lbs.
Actuation Force	750 psi, min.

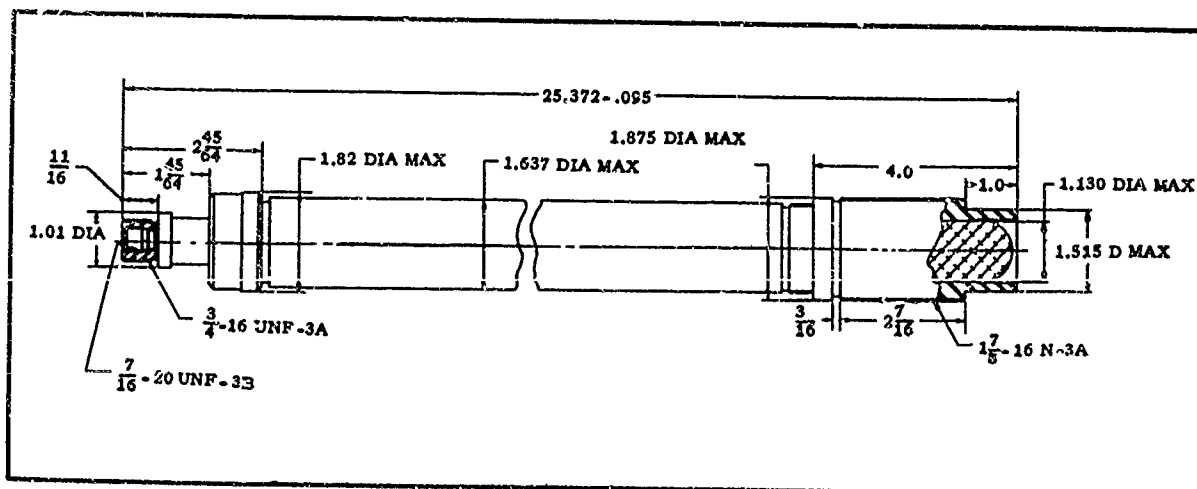
Propellant Actuated Devices

Thruster, Cartridge Actuated, M17



CROSS-SECTION DRAWING

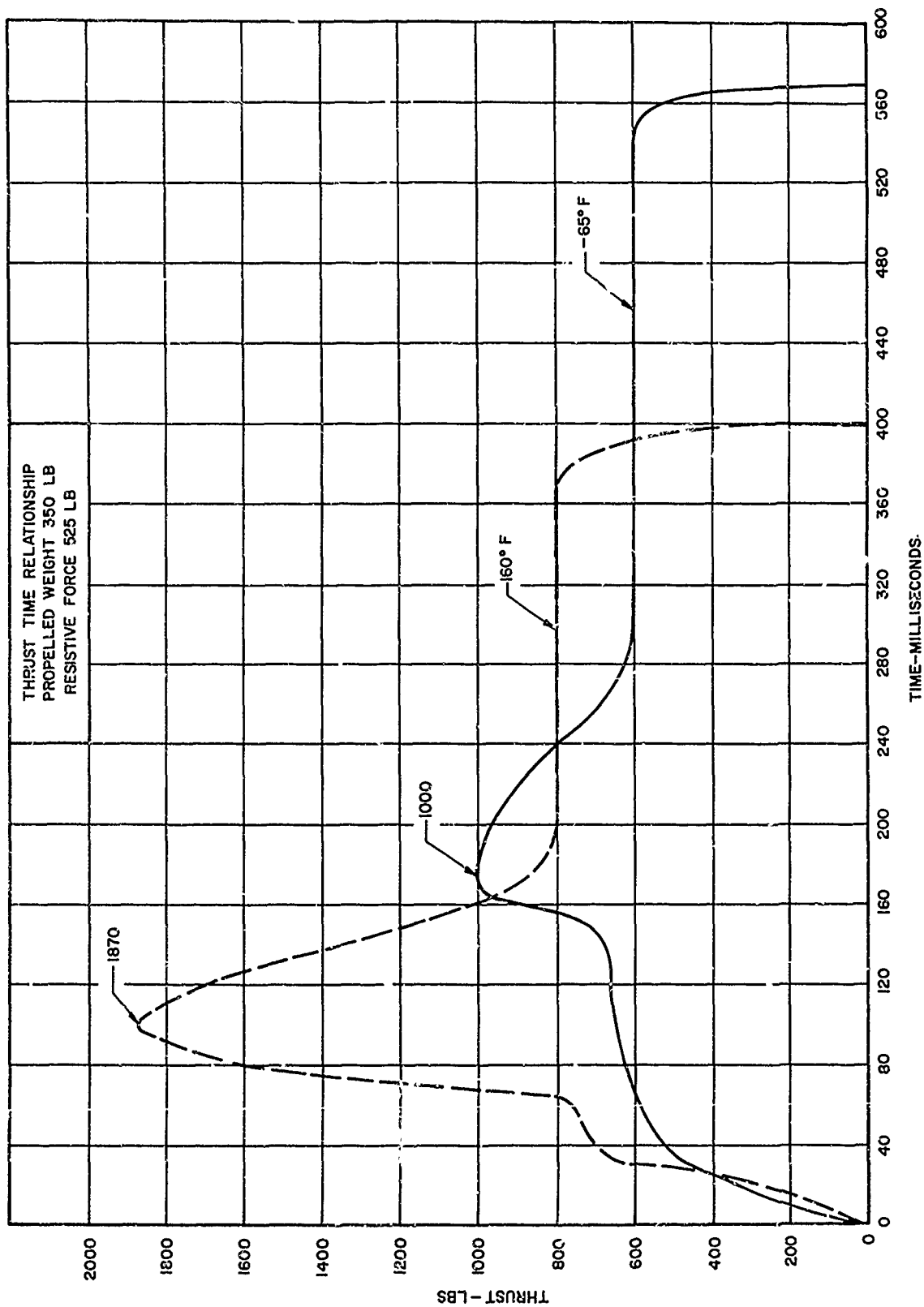
Component	Component
A Screw, Set	K Piston, Rod, End Assembly
B Head	L "O" Ring
C Washer	M Tube
D "O" Ring	N Piston
E Disc, Shear, Front	O Screw
F Ring	P Body
G Cap	Q Cartridge, Thruster, M43
H "O" Ring	R Pin, Firing
I "O" Ring	S "O" Ring
J Fluid	T Pin, Shear



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M17



Propellant Actuated Devices

Thrusters

M18 THRUSTER

The M18 Thruster is a component part of an aircraft escape system whose purpose is to position the seat in an aircraft prior to ejection of the crewman. The thruster is required to complete a 9-1/2 inch stroke against an opposing force. The opposing force is represented by a 350 pound mass that must be propelled against a force that increases from 0 to 525 pounds. The thruster uses oil for an internal damping medium to keep the acceleration of the propelled weight within limits consistent with human physiology.

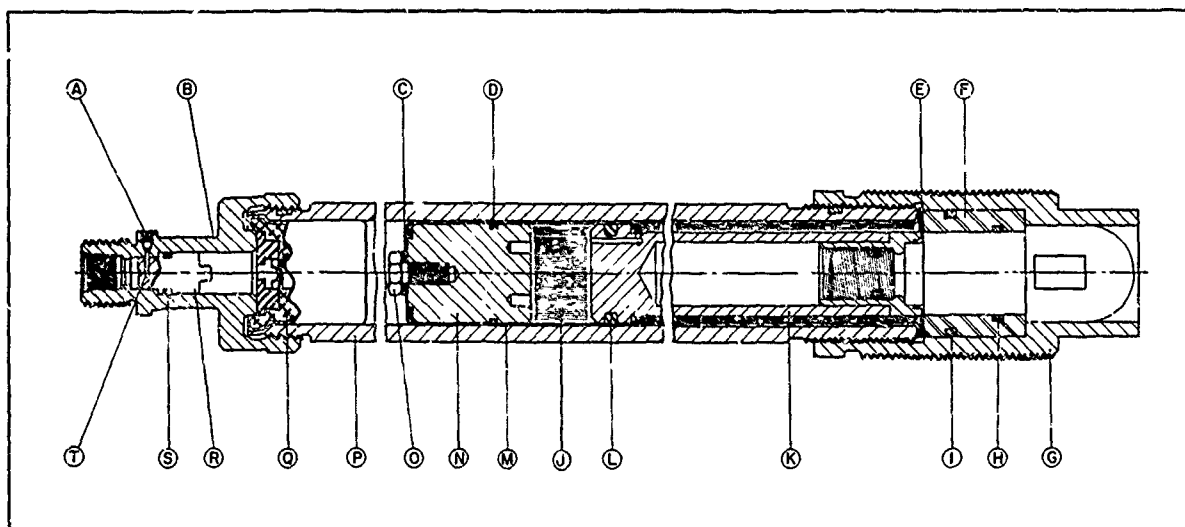
The thruster is cylindrical in shape, approximately 21.69 inches long and 1.32 inches in diameter. The piston is initially locked in the chamber with shear discs and will unlock upon application of a 700 pound tensile load.

PRINCIPAL CHARACTERISTICS

Average Thrust Under Load @ +165°F	1600 lbs.
Completed Stroke	9-1/2 inches
Max Piston Velocity	12 ft/sec
Assembled Weight	12 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +160°F
Propelled Mass	350 lbs.
Retaining Force	525 lbs.
Actuation Force	750 psi, min.

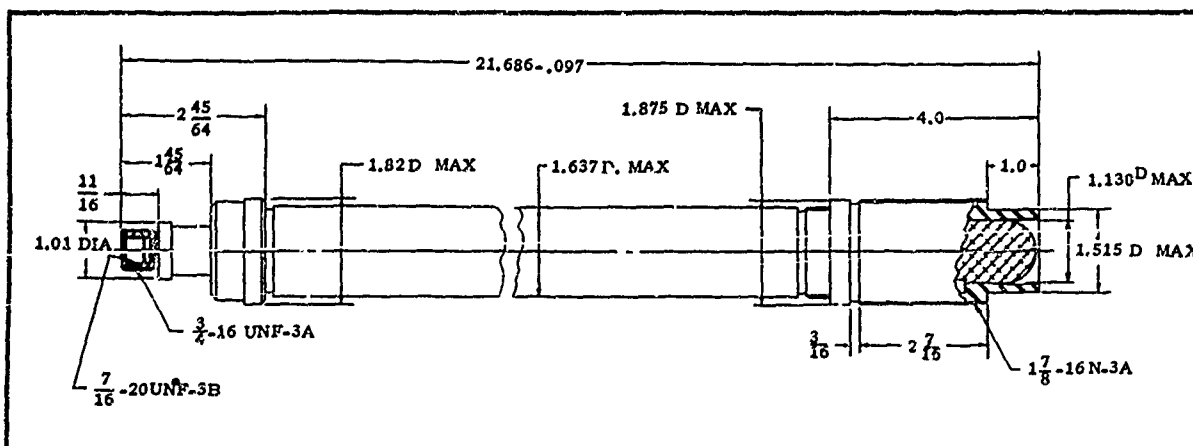
Propellant Actuated Devices

Thruster Cartridge Actuated, M18



CROSS-SECTION DRAWING

Component	Component
A Screw, Set	K Piston, Rod End Assembly
B Head	L "O" Ring
C Washer	M Tube
D "O" Ring	N Piston
E Disc, Shear, Front	O Screw
F Ring	P Body
G Cap	Q Cartridge, Thruster, M43
H "O" Ring	R Pin, Firing
I "O" Ring	S "O" Ring
J Fluid	T Pin, Shear



ENVELOPE DRAWING

Thrusters

M19 THRUSTER

The M19 Thruster is a component part of an aircraft escape system whose purpose is to unlock the canopy of an aircraft prior to implementing the escape procedures of aircraft personnel from the aircraft. The thruster is required to complete a stroke of 2.76 inches against an opposing force and supply 1000 psi pressure, minimum, at the end of a 13 foot 6 inch length of hose. The opposing forces distance is represented by two shear pins located with respect to initial piston position. The diameter of each pin was selected so that the shear force at a given distance is equal to the corresponding maximum opposing force in the above application. Thruster performance data using this test system is presented below.

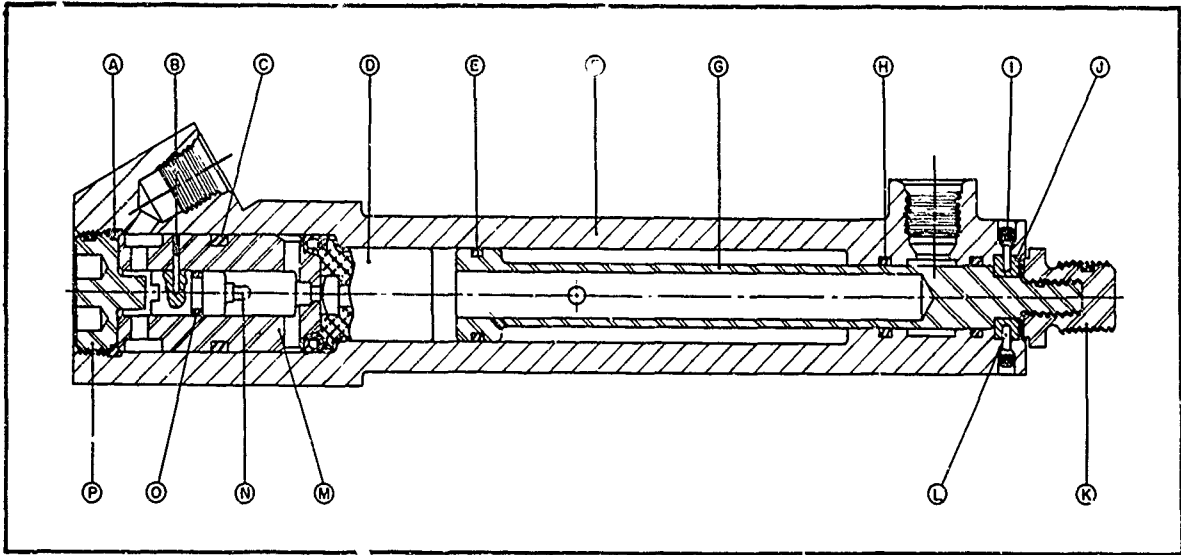
The thruster is cylindrical in shape, approximately 8.3 inches long and 1.2 inches in diameter. The piston is initially locked in the chamber with 2 "shear pins" and will unlock upon the application of a tensile load of 96 pounds.

PRINCIPAL CHARACTERISTICS

Peak Thrust Under Load @ 70°F	1470 lbs.
Completed Stroke	2.86 inches max.
Assembled Weight	1.07 lbs.
Propelled Mass	75 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
By-Pass Pressure Under Load @ 13 Feet 6 Inch Length of #4 Hose	1000 psi
Restraining Force	25 lbs. @ "0" inch stroke, 500 lbs. @ "2.4" inch stroke
Operating Time	.080 seconds, max.
Actuation Force	750 psi, min.

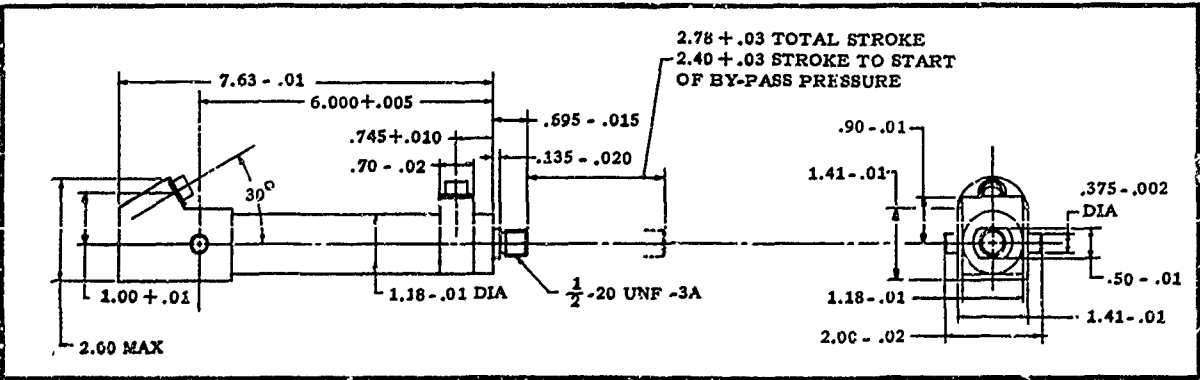
Propellant Actuated Devices

Thruster, Cartridge Actuated, M19



CROSS-SECTION DRAWING

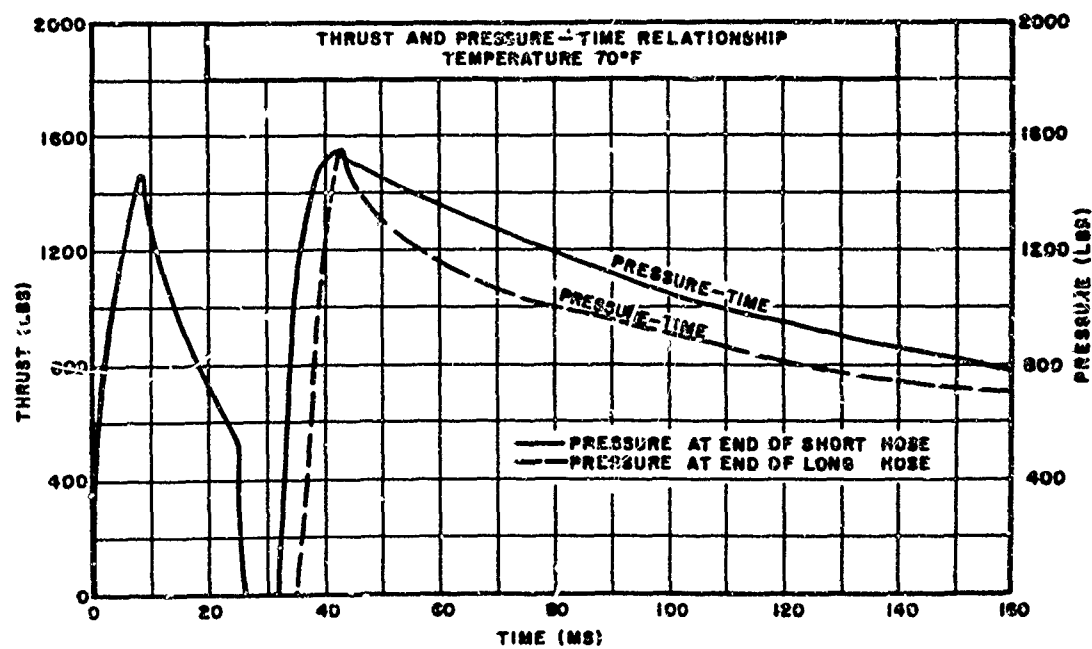
Component	Component
A "O" Ring	I Screw, Set (2)
B Pin, Shear, Firing Pin	J Ring, Shear
C "O" Ring	K Fastener, Piston and Pellet Assembly
D Cartridge, Thruster, M119	L Pin, Shear, Piston (2)
E "O" Ring	M Breech
F Body	N Pin, Firing
G Piston	O "O" Ring
H "O" Ring (2)	P Cap, Base and Pellet Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Thruster, Cartridge Actuated, M19



Thrusters

M20A1 THRUSTER

The M20A1 Thruster is a component part of an aircraft system whose purpose is to jettison the canopy of an aircraft prior to implementing the escape procedure of aircraft personnel from the aircraft. The thruster is required to complete a 5 inch stroke against a constant force. With the thruster connected to a 50 pound weight, the piston shall move a constant load of 3000 pounds, horizontally, throughout its entire 5 inch stroke.

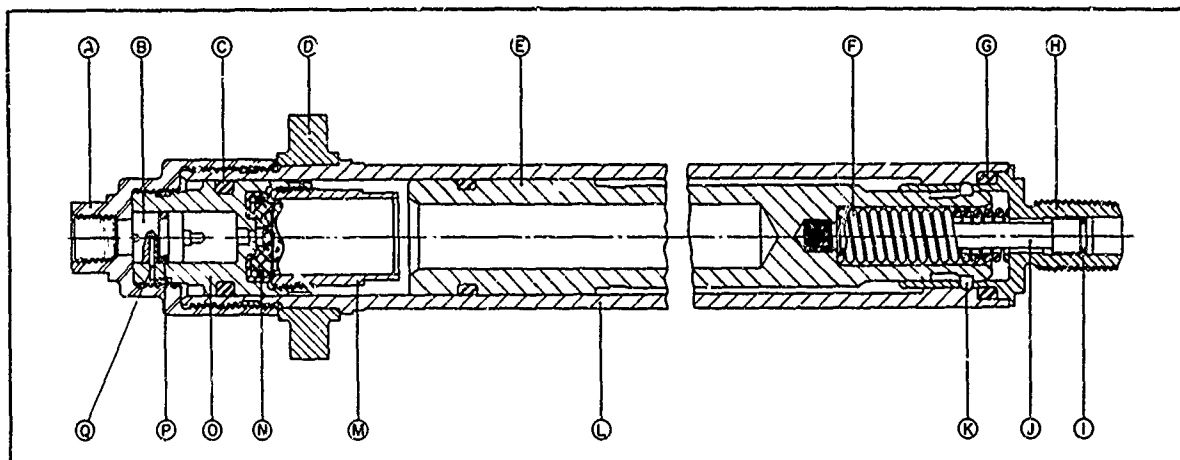
The thruster is cylindrical in shape, approximately 12.6 inches long and 1.4 inches in diameter. The piston is initially locked by 4 keys in a locking groove and will withstand a tensile load of 2000 pounds without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

Average Peak Thrust Under Normal Load @ 70°F	5877 lbs.
Completed Stroke	5.0 inches
Average Stroke Time	.046 sec.
Assembled Weight	3.6 lbs.
Propelled Mass, Horizontal	50 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Restraining Force	3000 lbs.
Force Required to Unlock Initial Lock	60 lbs.
Actuation Force	750 psi min

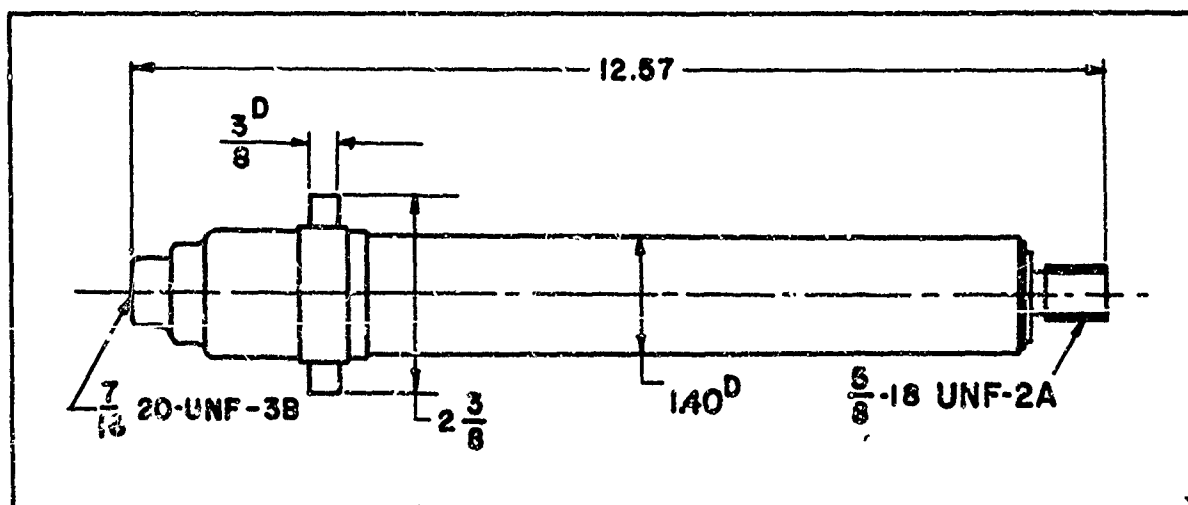
Propellant Actuated Devices

Thruster, Cartridge Actuated, M20A1



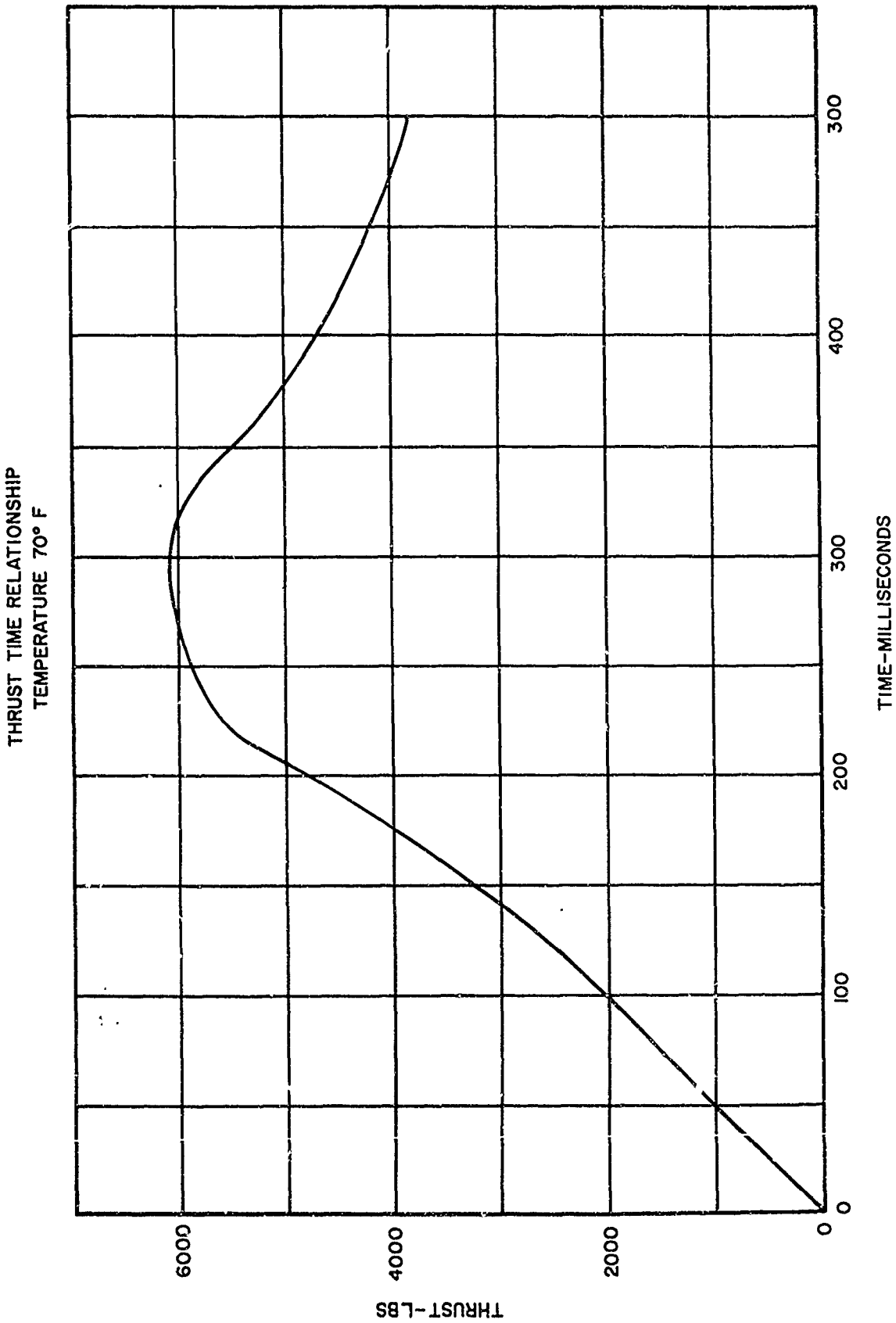
CROSS-SECTION DRAWING

Component	Component
A Head	J Screw, Buffer and Pellet Assembly
B Pin, Firing	K Key (4)
C "O" Ring (2)	L Body and Pellet Assembly
D Trunnion	M Sleeve
E Piston	N Cartridge, Thruster, M127
F Spring	O Guide Retainer Assembly
G "O" Ring	P "O" Ring
H Sleeve, End	Q Pin, Shear
I "O" Ring	



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M20A1



Propellant Actuated Devices

Thrusters

M25 THRUSTER

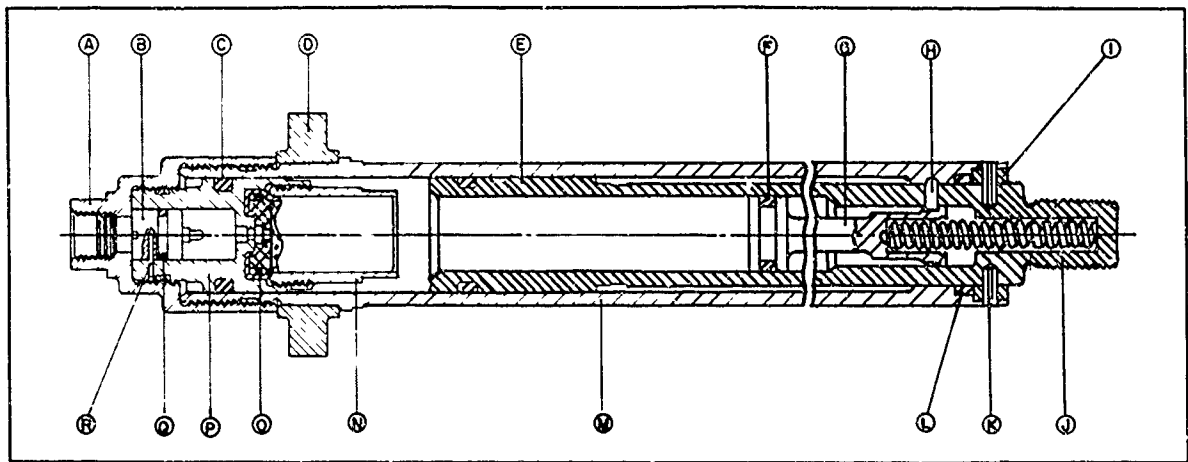
The M25 Thruster is a component part of an aircraft system whose purpose is to jettison the canopy of an aircraft prior to implementing the escape procedure of aircraft personnel from the aircraft. The thruster is required to complete a 5 inch stroke against a constant force. With the thruster connected to a 50 pound weight, the piston shall move a constant load of 3000 pounds, horizontally, throughout its entire 5 inch stroke.

The thruster is cylindrical in shape, approximately 12.6 inches long and 1.4 inches in diameter. The piston is initially locked by 4 keys in a locking groove and will withstand a tensile load of 2000 pounds without separation or mechanical failure.

PRINCIPAL CHARACTERISTICS

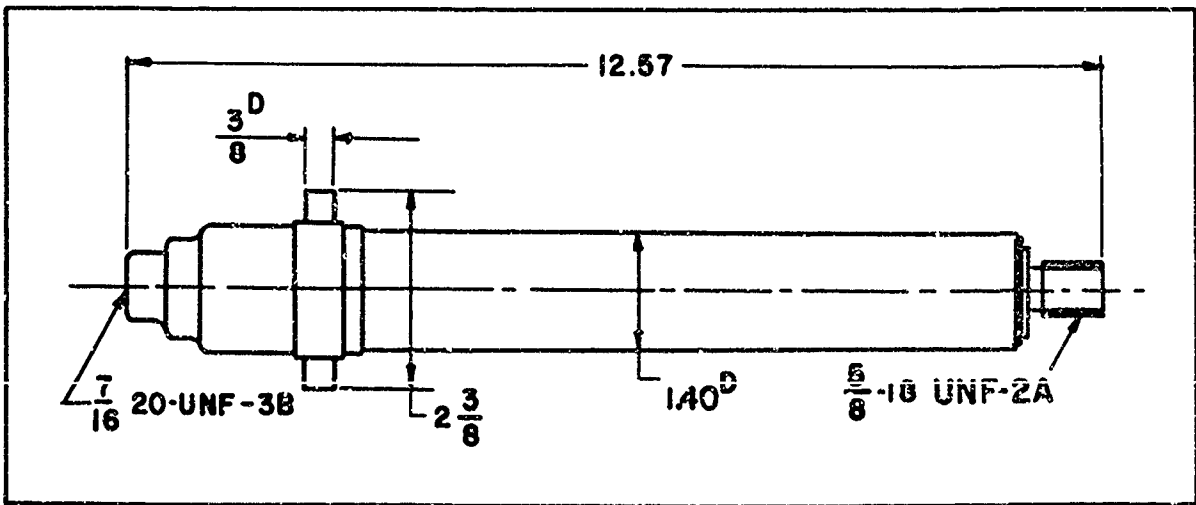
Average Peak Thrust Under Normal Load @ 70°F	5877 lbs.
Completed Stroke	5.0 inches
Average Stroke Time	.046 sec.
Assembled Weight	3.6 lbs.
Propelled Mass, Horizontal	50 lbs.
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Restraining Force	3000 lbs.
Force Required to Unlock Initial Lock	60 lbs.
Actuation Force	750 psi, min.

Thruster, Cartridge Actuated, M25



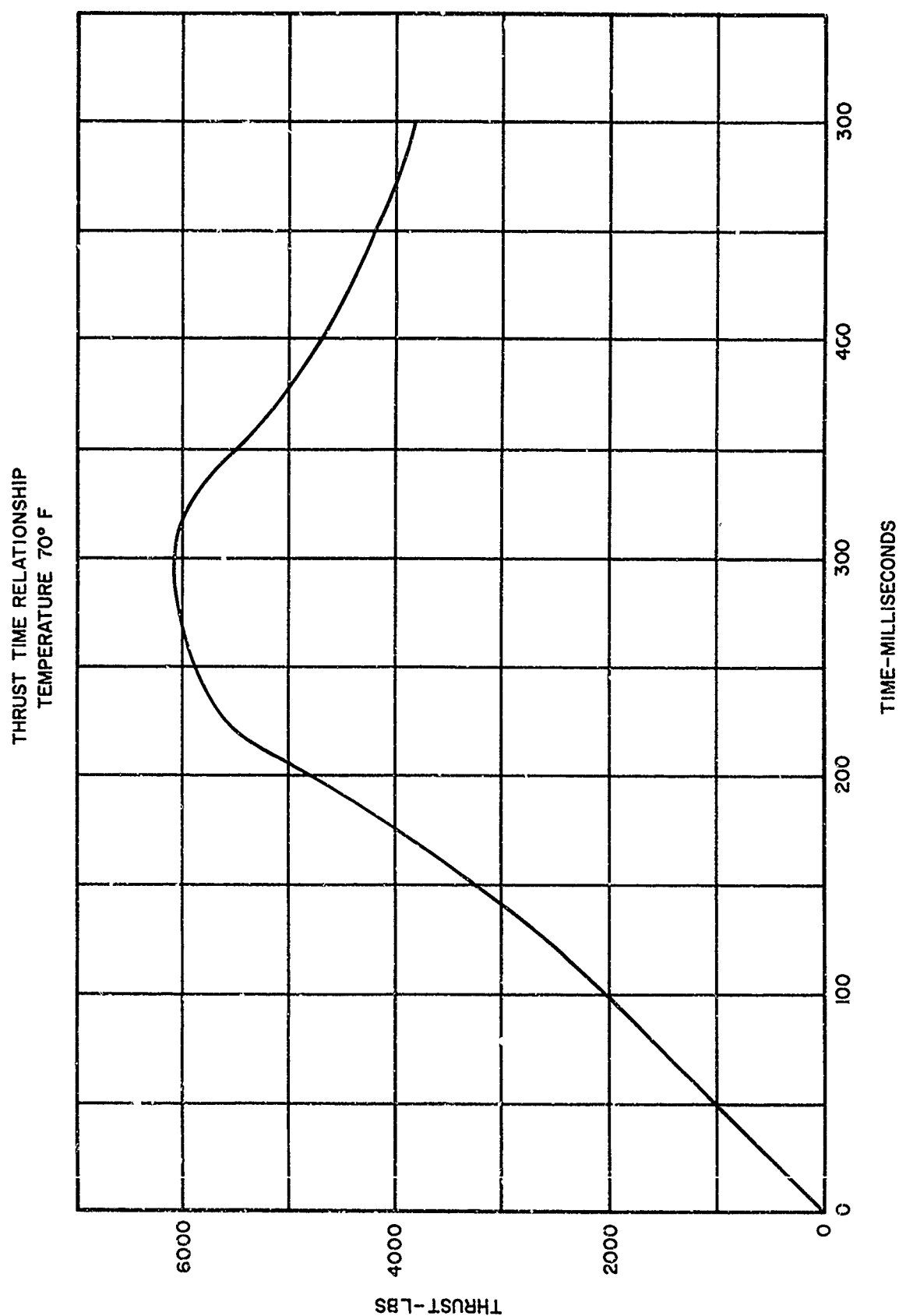
CROSS-SECTION DRAWING

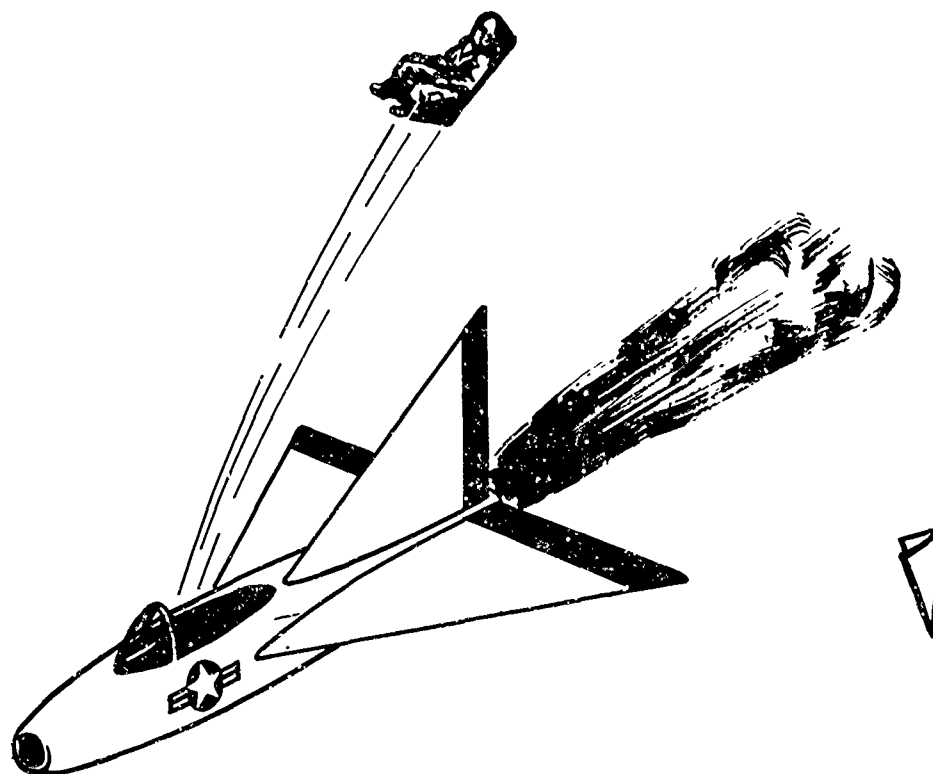
Component	Component
A Head	J Spring
B Pin, Firing	K Pin, Spring
C "O" Ring (2)	L "O" Ring
D Trunnion	M Body
E Piston	N Sleeve
F "O" Ring	O Cartridge Thruster
G Piston, Unlocking	P Guide Retainer Assembly
H Key (3)	Q "O" Ring
I Ring, Shear	R Pin, Shear



ENVELOPE DRAWING

Thruster, Cartridge Actuated, M25





SECTION III

CATAPULTS

Catapults

INTRODUCTION

Description

The catapult is a two or three tube telescoping device, containing an explosive component, designed for upward or downward ejection of crewmen and their seat from high-speed aircraft to provide safe escape from disabled aircraft.

Operation

The catapult must impart to its load (ejection seat with occupant), a velocity which will insure its clearing the aircraft and reach sufficient height to permit full deployment of a parachute, at the same time keeping the acceleration within safe physiological limits.

Two additional types of catapults have been designed to indoctrinate USAF trainees in the catapult ejection procedures; namely, one type which is used on a fixed vertical training tower and a mobile type which propels the seat and occupant along a guided vertical track.

Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, M1A1

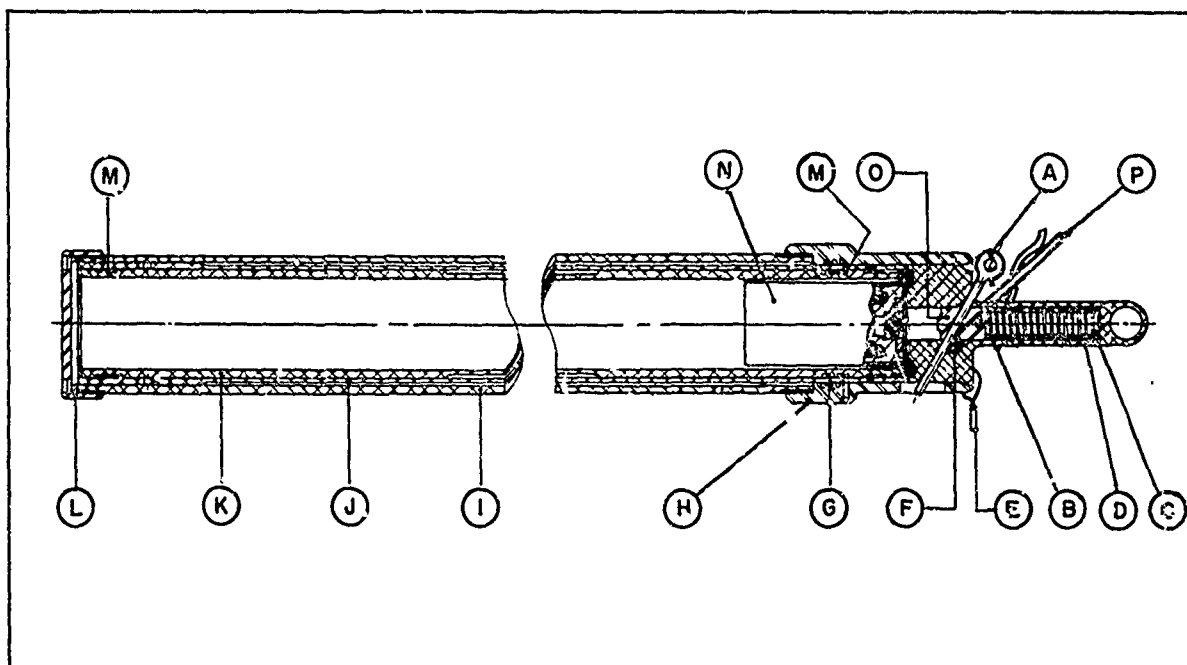
The first catapult developed for USAF was the mechanically actuated M1A1 Catapult. The catapult is a three tube telescoping ejection device, containing an explosive cartridge, designed for upward ejection of crewmen and their seat from high speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 39 inches long and 2.3 inches in diameter. The catapult is actuated by removal of the safety locking pin first and manual operation of the sear through a pulley system connected to a lever on the pilot's seat. Rotation of the sear unlocks the catapult tubes and releases the spring loaded firing pin which strikes and detonates the primer, thereby igniting the black powder and propellant in the M28A1 Cartridge. The catapult thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the trunnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

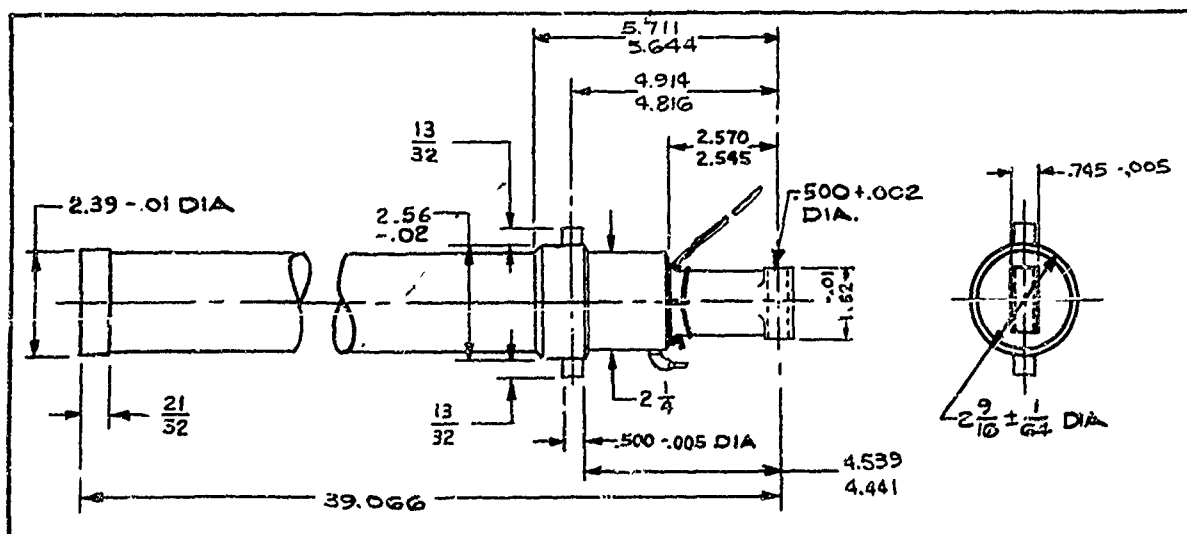
Stroke	66.0 inches
Weight (total assembly)	8.2 pounds
Propelled Weight	300.0 pounds
Temperature Limits	-65°F to +160°F
Max Acceleration (at 70°F)	20.0 g
Velocity, min (at 70°F)	60.0 fps
Max. Rate of Change of Acceleration (at 70°F)	170.0 g/sec
Firing method	Mechanical Actuation
Stroke Time (at 70°F)	0.220 sec

Catapult, Aircraft Ejection Seat, M1A1



CROSS-SECTION DRAWING

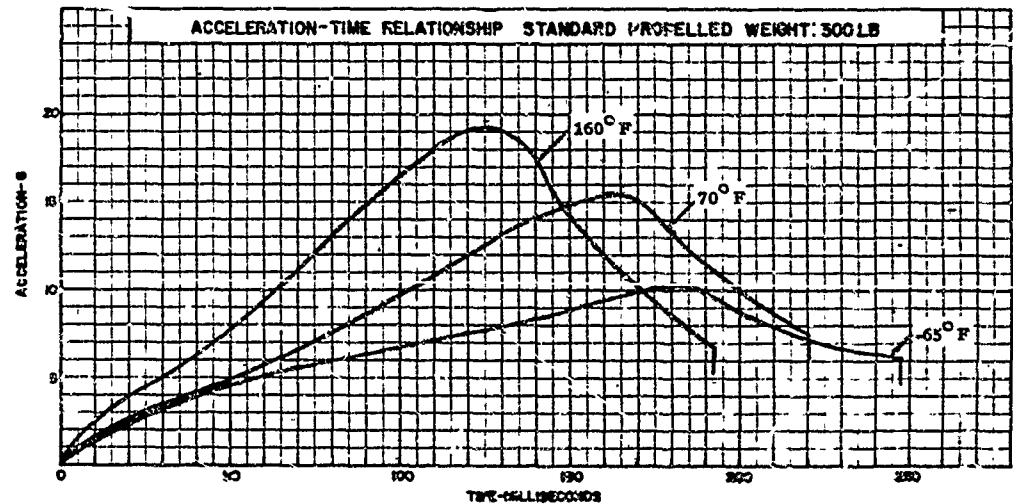
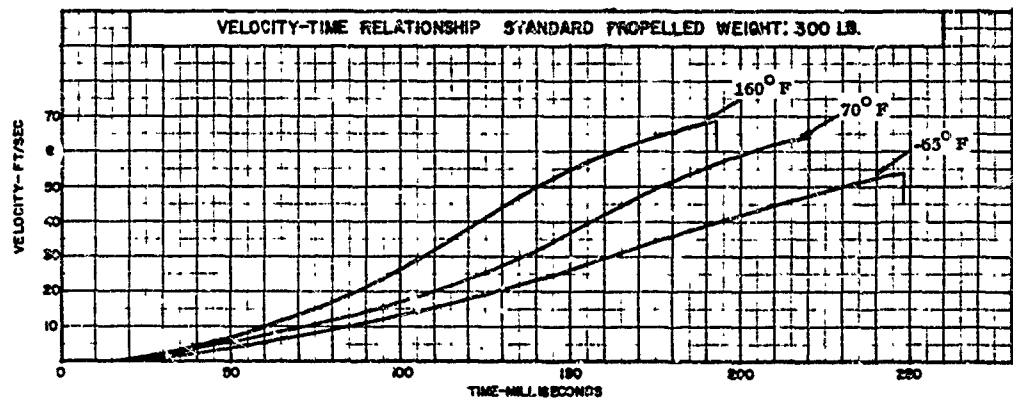
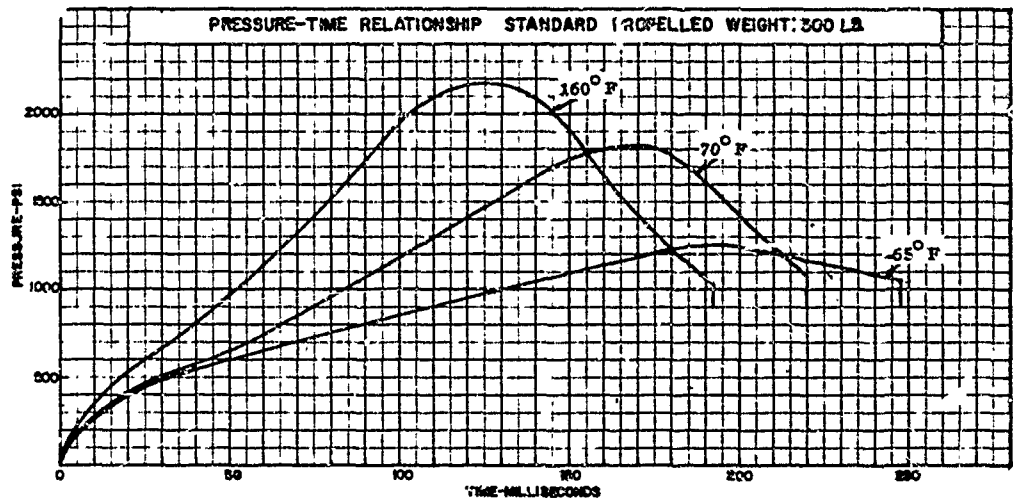
Component	Component
A Pin, Locking	I Tube, Outside
B Wire, Locking	J Tube, Telescoping
C Spring, Firing Pin	K Tube, Inside
D Block Assembly	L Cap
E Seal, Lead	M Seal, Plain
F Sear	N Cartridge, Aircraft Ejection Seat, Catapult, M28A1
G Seal, Fixed	O Pin, Firing
H Trunnion	P Pin, Safety, Assembly



ENVELOPE DRAWING

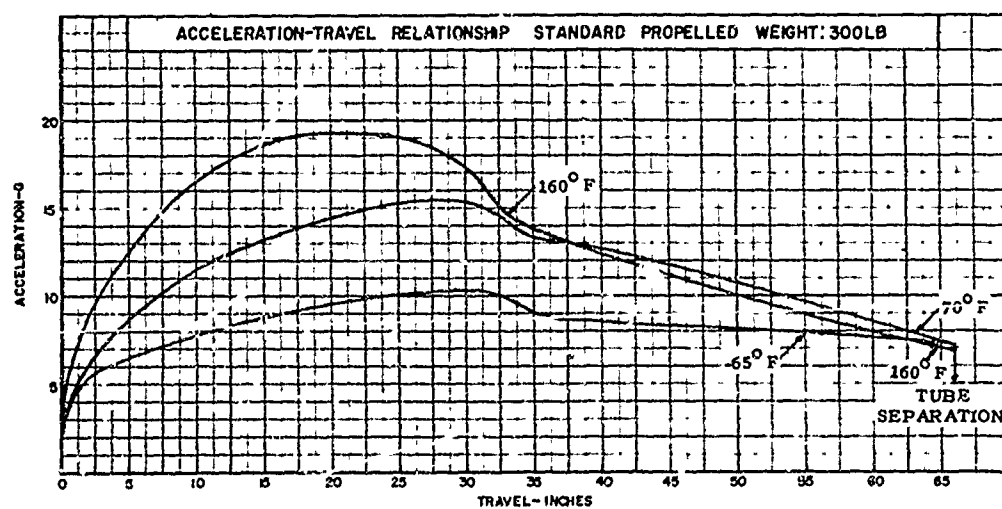
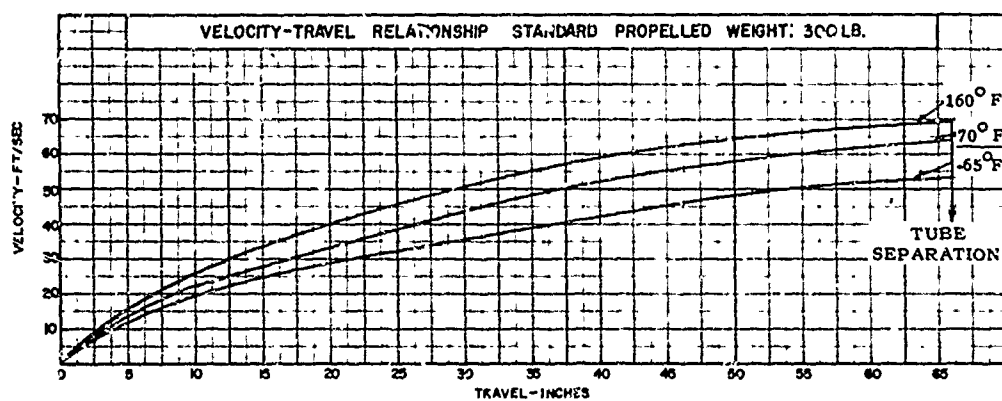
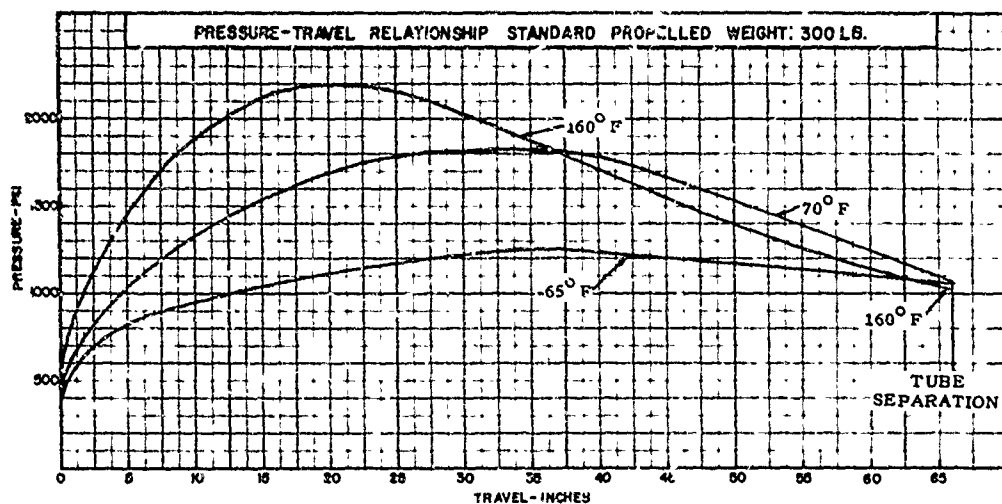
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M1A1



Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M1A1



Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, TRAINING, M2

The Catapult, Aircraft Ejection Seat, Training, M2 with the Cartridge M30A1 was designed to be used on a fixed vertical training tower for indoctrinating United States Air Force trainees in the catapult ejection procedure. In this application, the catapult ejects the seat and occupant along a guided track to about a height of 40 feet with moderate acceleration.

The training catapult is a three-tube, mechanically actuated unit which is constructed of steel. This catapult is approximately 39 inches long and 2.2 inches in diameter. After removal of the safety locking pin, the catapult is actuated by manual rotation of the sear through a pulley system connected to the actuating lever on the indoctrinee's seat. Rotation of the sear releases the spring-loaded firing pin which strikes and detonates the primer, thereby igniting the black powder and propellant in the M30A1 Cartridge. The Catapult thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the trunnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the simulated cockpit.

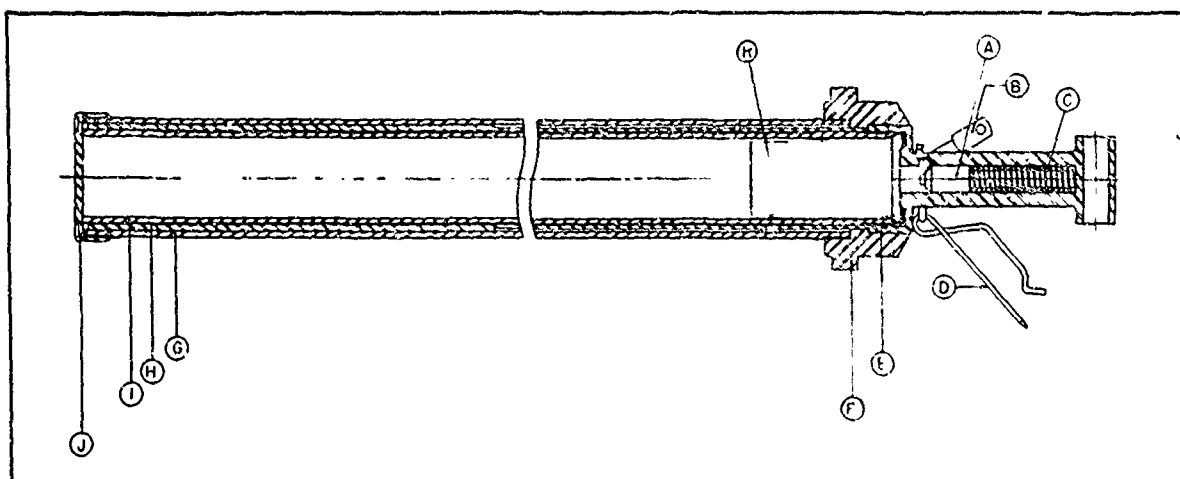
The catapult is designed for repeated use on a fixed tower installation, with a new cartridge inserted for each firing.

PRINCIPAL CHARACTERISTICS

Stroke	60.0 inches
Weight (total assembly)	13.0 pounds
Propelled Weight	300.0 pounds
Temperature Limits	-65°F to +160°F
Max Acceleration (at 70°F)	12.0 g
Velocity, min (at 70°F)	38 fps
Max Rate of Change of Accel (at 70°F)	150 g/sec
Firing Method	Mechanical Actuation
Stroke Time (at 70°F)	0.210 seconds

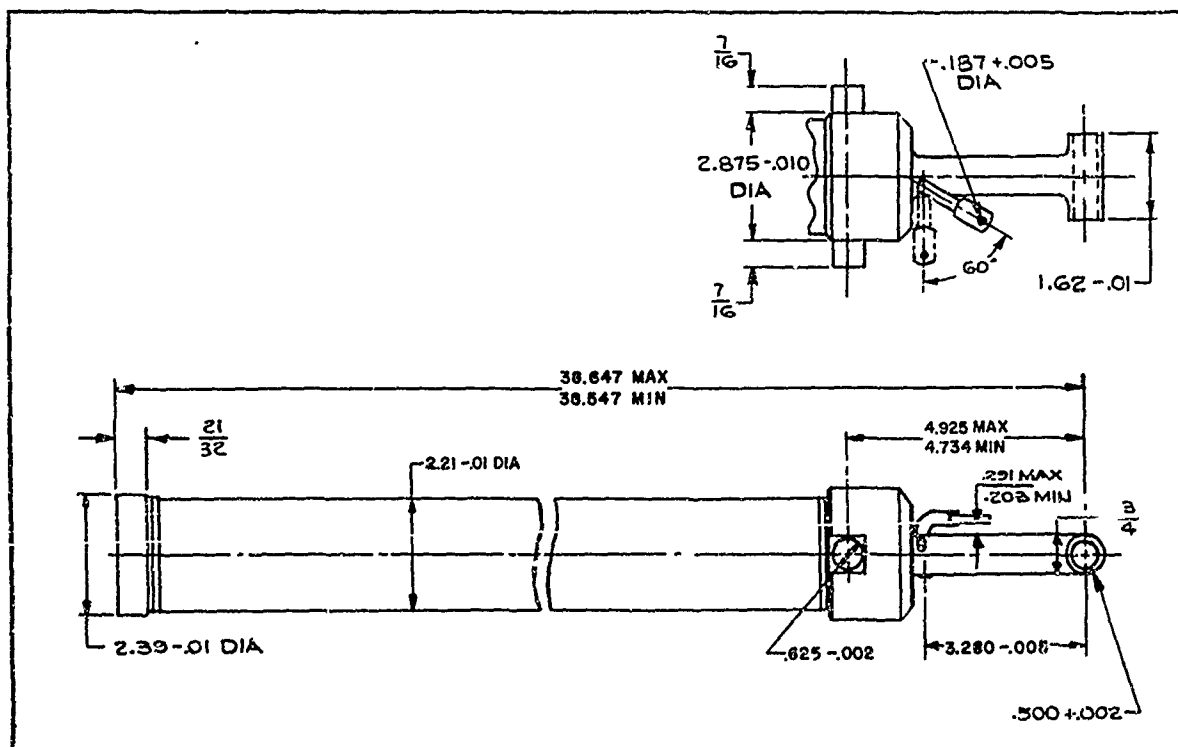
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, Training, M2



CROSS-SECTION DRAWING

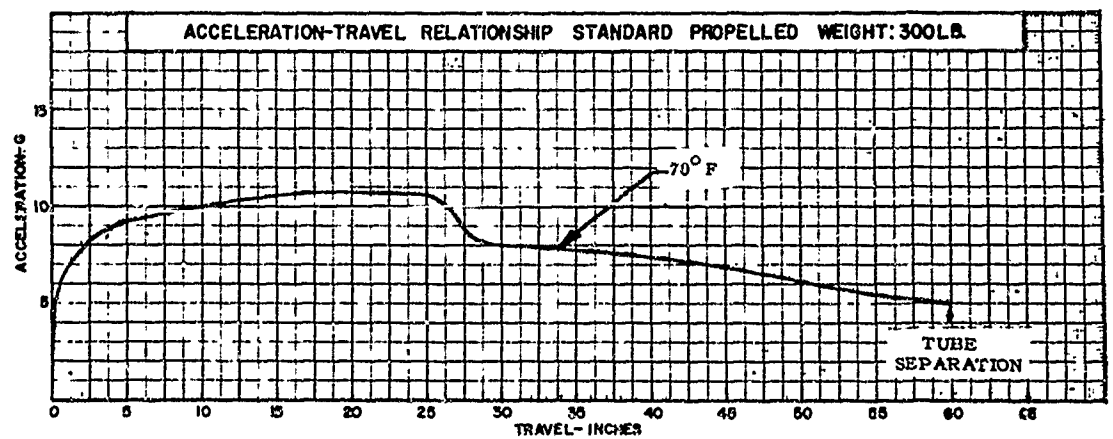
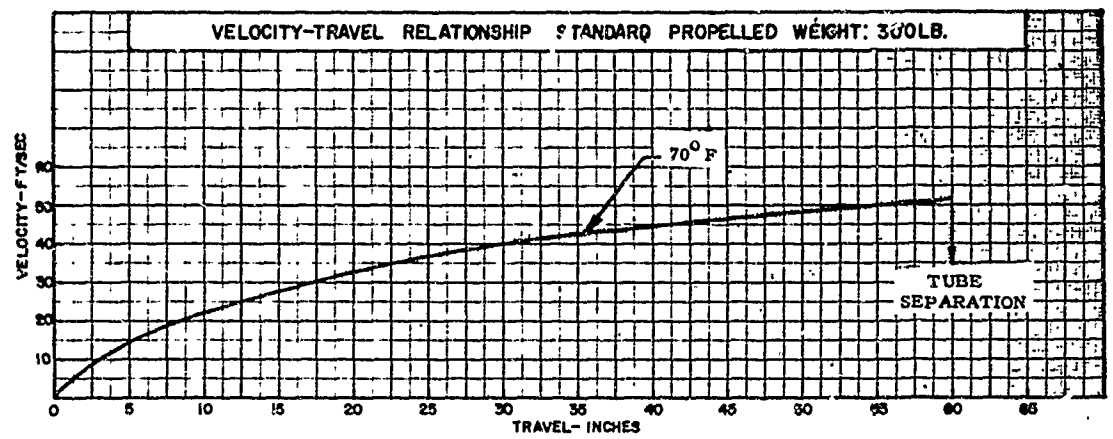
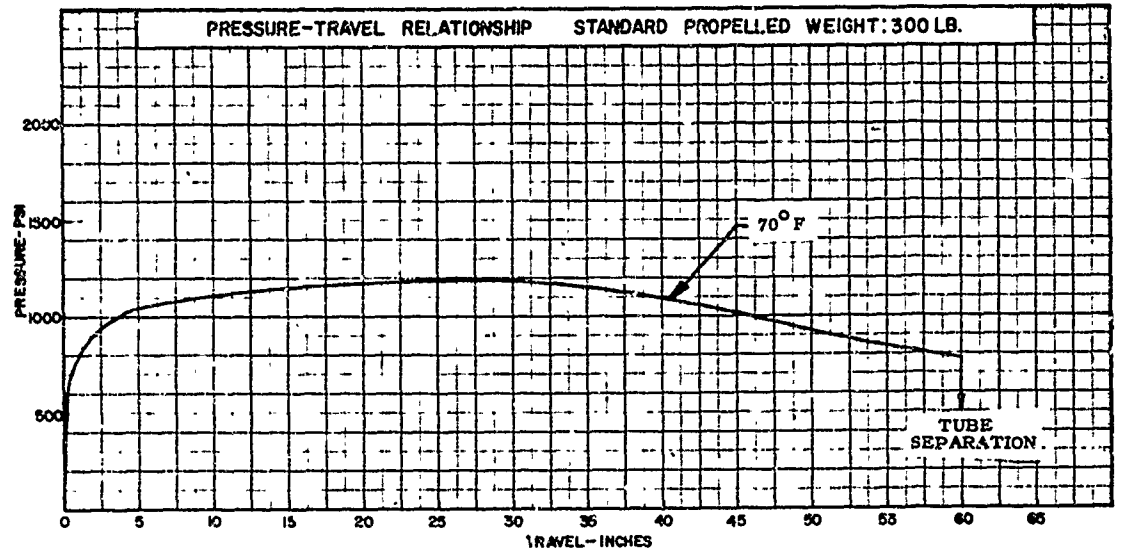
Component	Component
A Pin, Firing	G Tube, Outside
B Sear	H Tube, Telescoping
C Spring, Firing Pin	I Tube, Inside
D Pin, Safety, Assembly	J Cap
E Block	K Cartridge, Aircraft Ejection Seat
F Trunnion	Catapult, M30 A1 - (Installed at Training Base)



ENVELOPE DRAWING

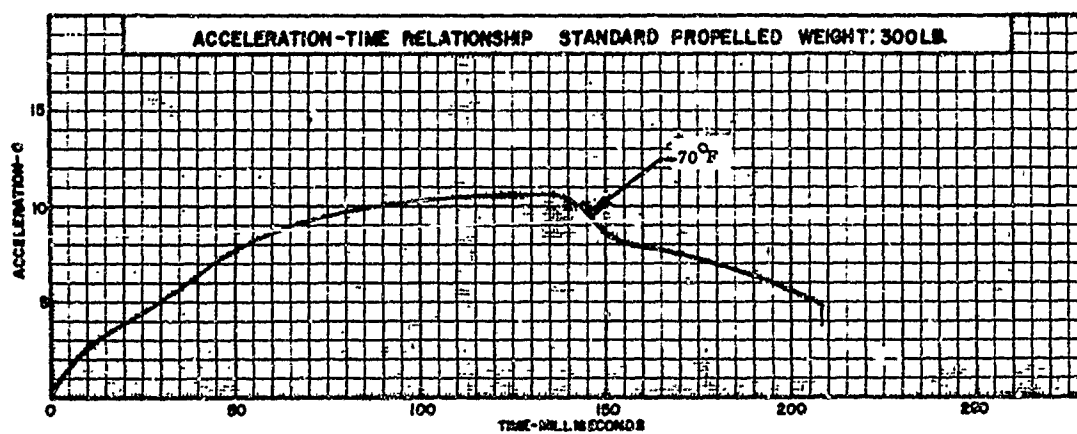
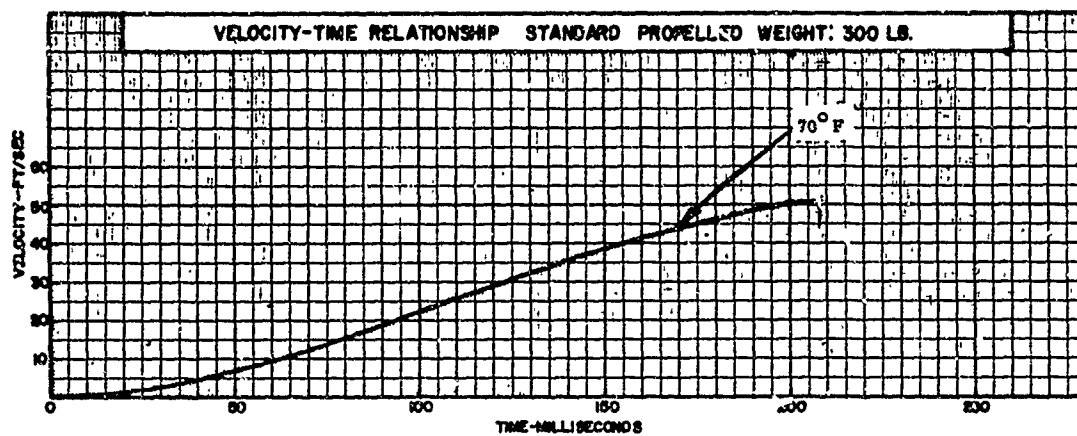
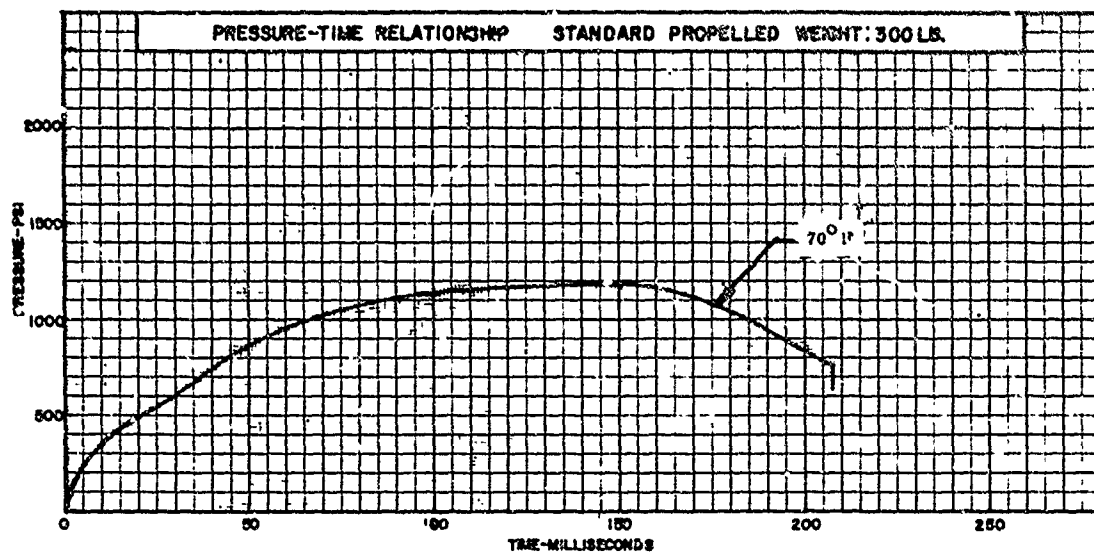
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, Training, M2



Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, Training, M2



Propellant Actuated Devices

Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, M3A1

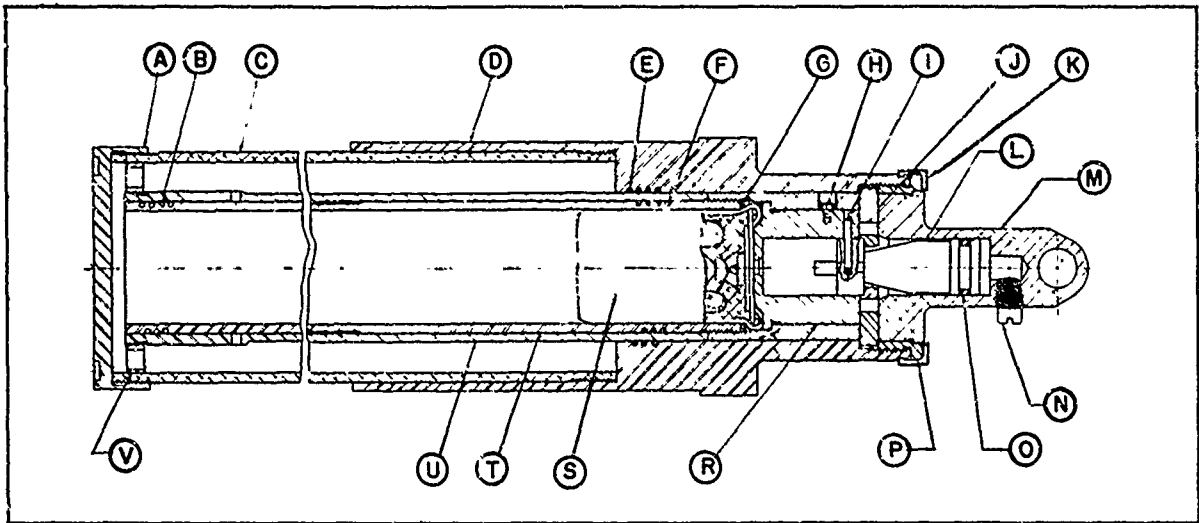
The M3A1 Catapult is a gas actuated three-tube telescoping device containing an explosive cartridge, designed to propel upward, an ejection seat together with a crewman from high-speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 51 inches long and 3.0 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M36 Cartridge. The catapult is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The catapult thrust which is developed from the expanding gases of the burning propellant forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the trunnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

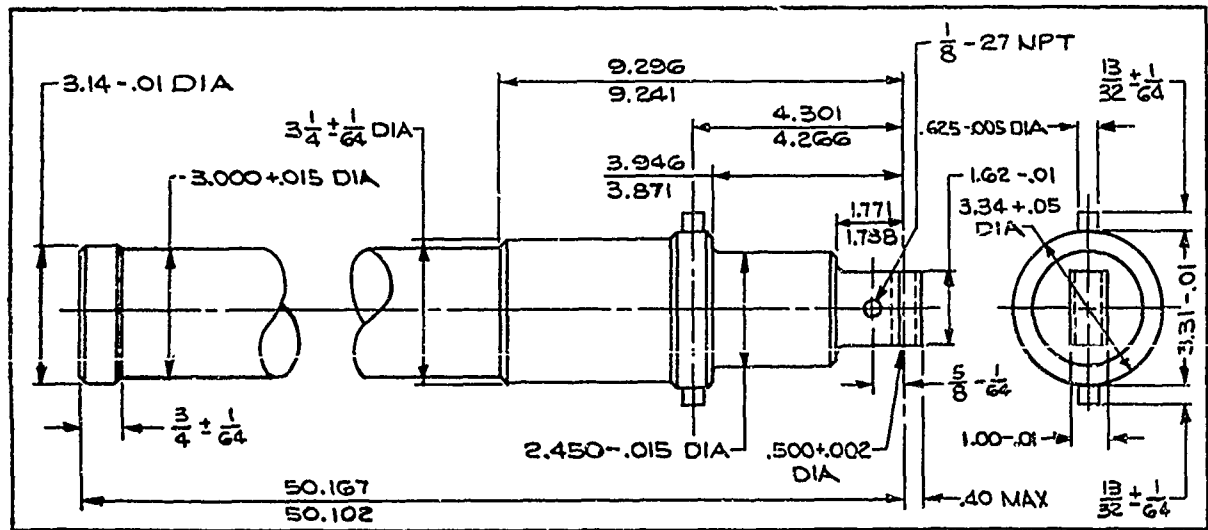
Stroke	88.0 inches
Weight (total assembly)	24.9 pounds
Propelled Weight	350.0 pounds
Temperature Limits	-65°F to +160°F
Max Accel. (at 70°F)	20.0 g
Velocity, min. (at 70°F)	77.0 fps
Max Rate of Change of Accel (at 70°F)	180.0 g/sec
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.240 sec

Catapult, Aircraft Ejection Seat, M3A1



CROSS-SECTION DRAWING

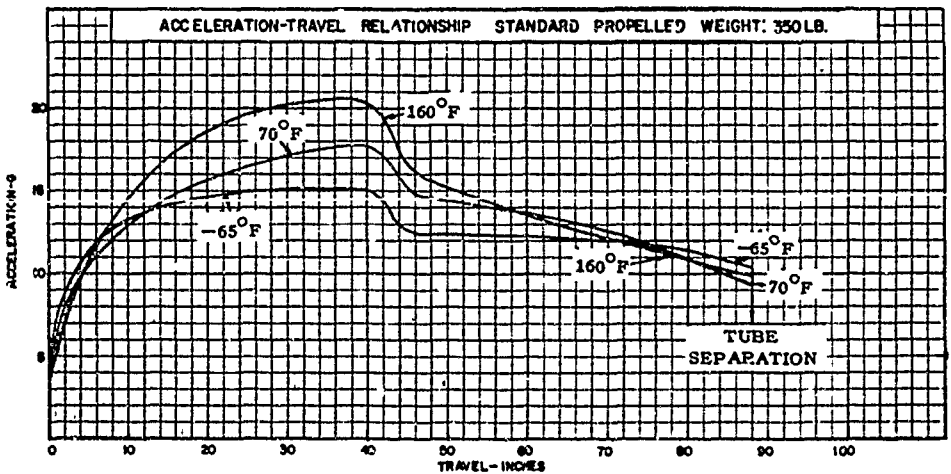
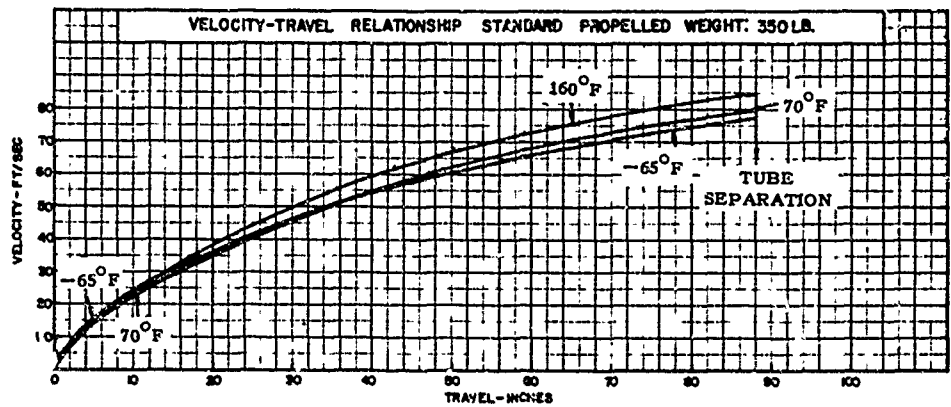
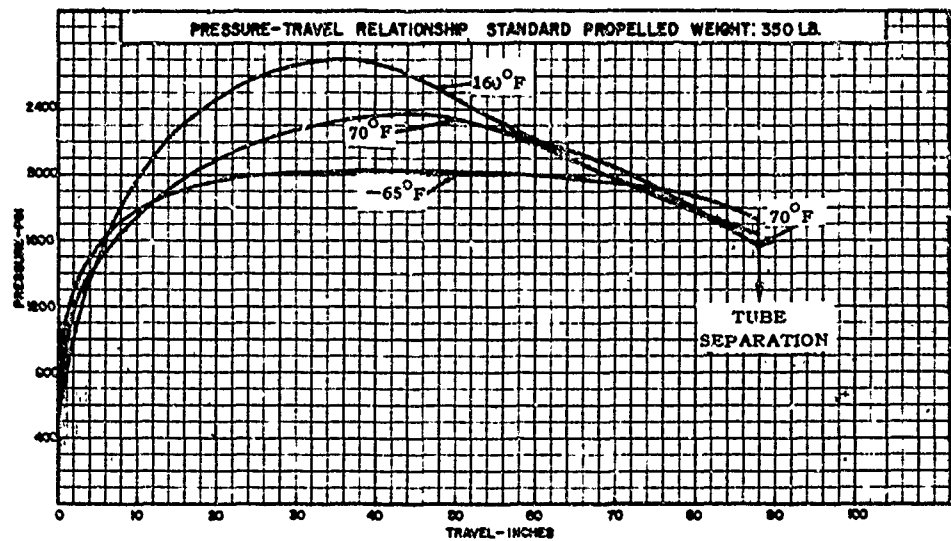
Component	Component
A Cap	L Pin, Firing
B Seal, Plain	M Block
C Tube, Outside and Pellet Assembly	N Plug, Shipping
D Trunnion	O "O" Ring
E Seal, Fixed	P Ring, Stop and Pellet Assembly
F Seal, Plain	R Plug
G Washer, Shock	S Cartridge, Aircraft Ejection Seat, Catapult, M36
H Screw, Cap, Socket Head, Self-Locking (shown out of position)	T Tube, Inside and Pellet Assembly
I Pin, Shear	U Tube, Telescoping
J Latch (2)	V Spacer
K Seal, Tamper Proof	



ENVELOPE DRAWING

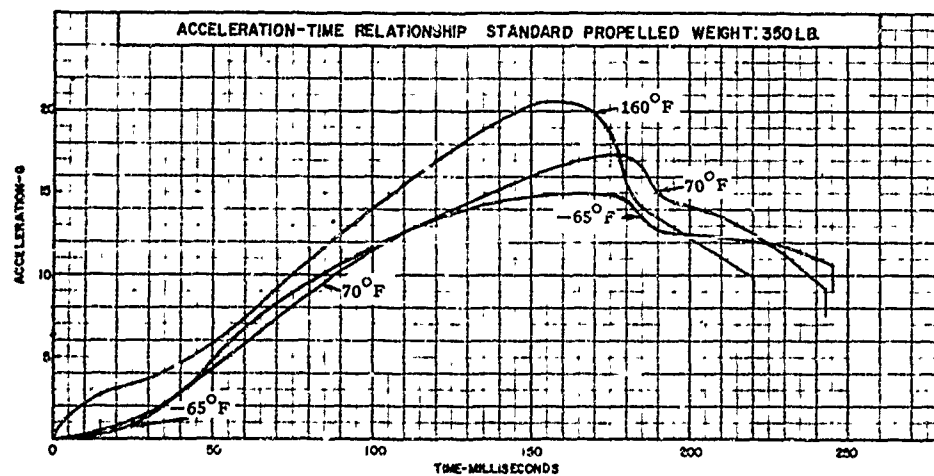
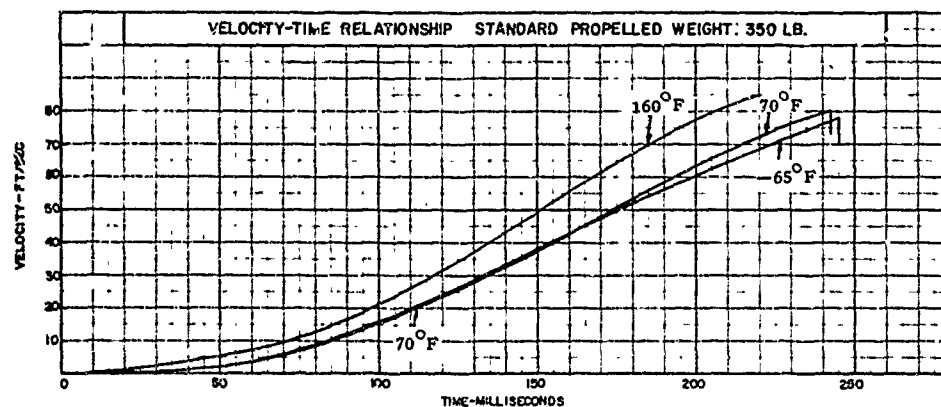
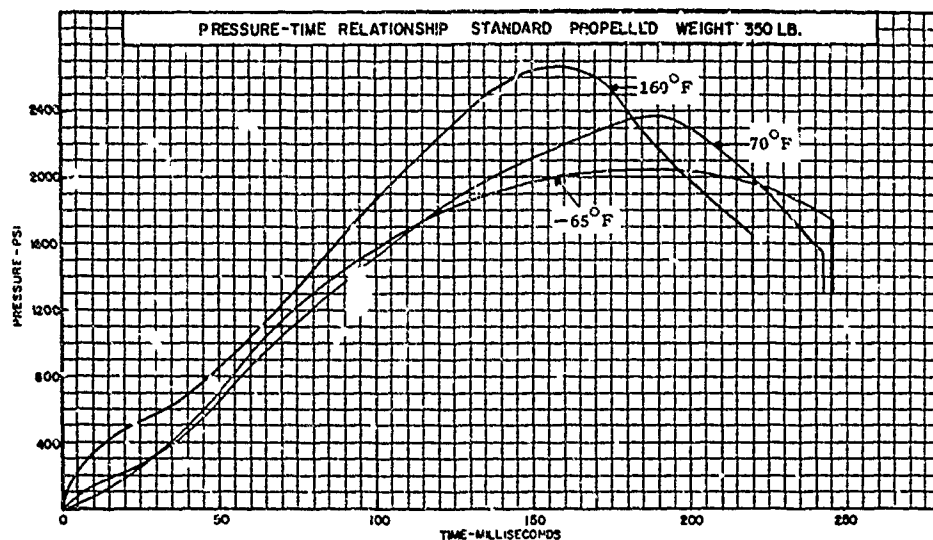
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M3A1



Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M3A1



Propellant Actuated Devices

Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, M4A1

The M4A1 Catapult is a gas actuated three-tube telescoping device, containing an explosive cartridge, designed to propel downward, an ejection seat together with a crewman from high-speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 31 inches long and 2.6 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M37 Cartridge. The catapult is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The catapult thrust which is developed from the expanding gases of the burning propellant, forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the ring tube stop, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	45.0 inches
Weight (total assembly)	6.7 pounds
Propelled Weight	325.0 pounds
Temperature Limits	-65°F to +160°F
Max Accel (at 70°F)	12.5 g
Velocity, min. (at 70°F)	38.0 fps
Max rate of change of Accel (at 70°F)	100.0 g/sec
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.240 sec

Catapult, Aircraft Ejection Seat, M4A1



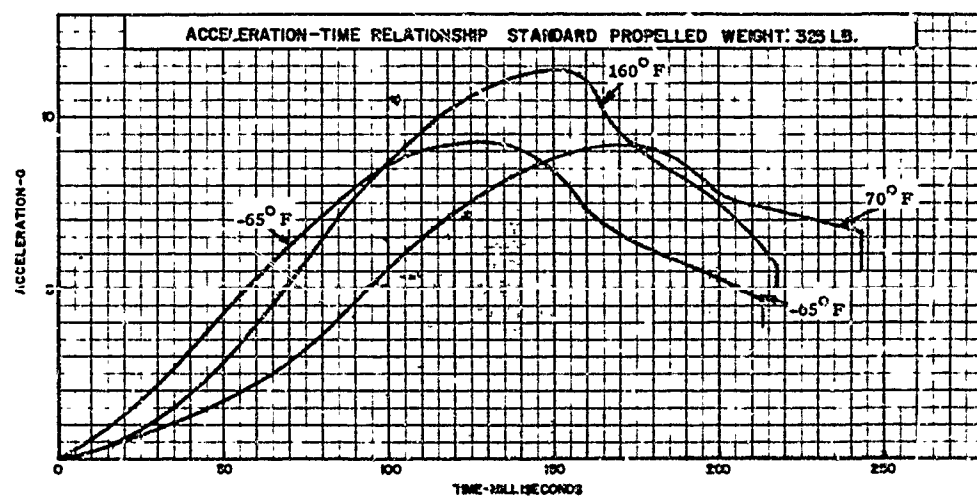
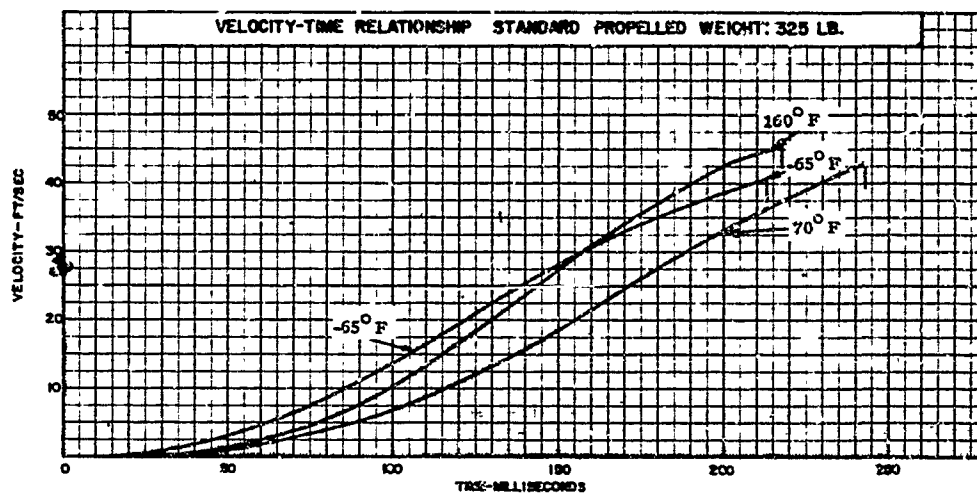
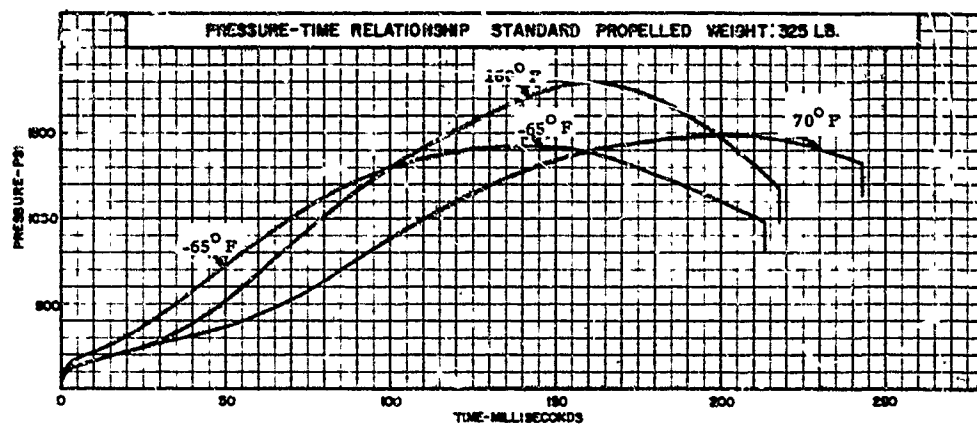
Component

- M "O" Ring
- N Seal, Tamper Pk of
- O Latch (2)
- P Plug
- Q Washer, Shock
- R Seal, Fixed
- S Tube, Inside & Pellet Assembly
- T Seal, Plain
- U Cap & Pellet Assembly
- V Cartridge, Aircraft Ejection Seat
Catapult, M37



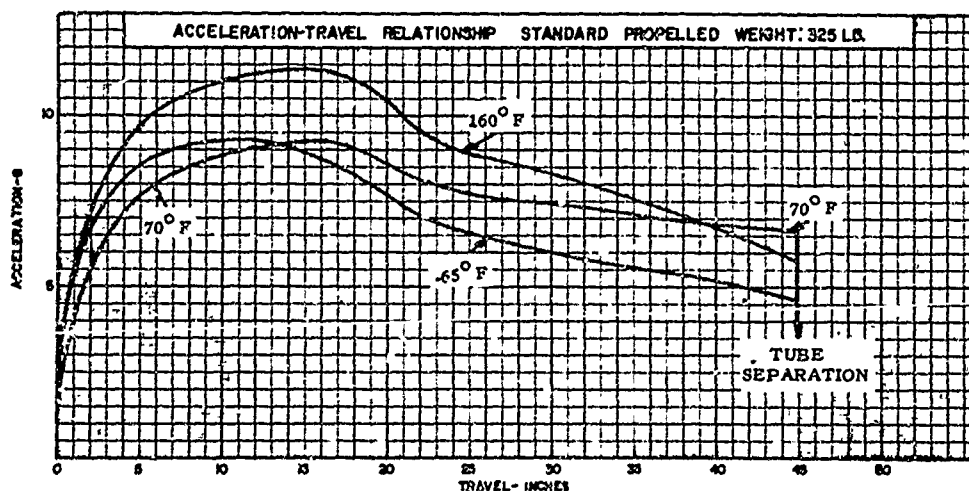
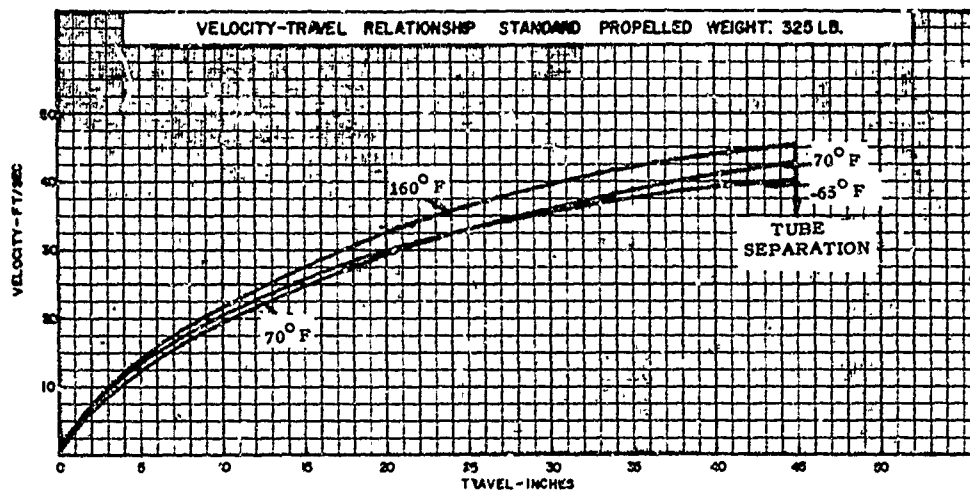
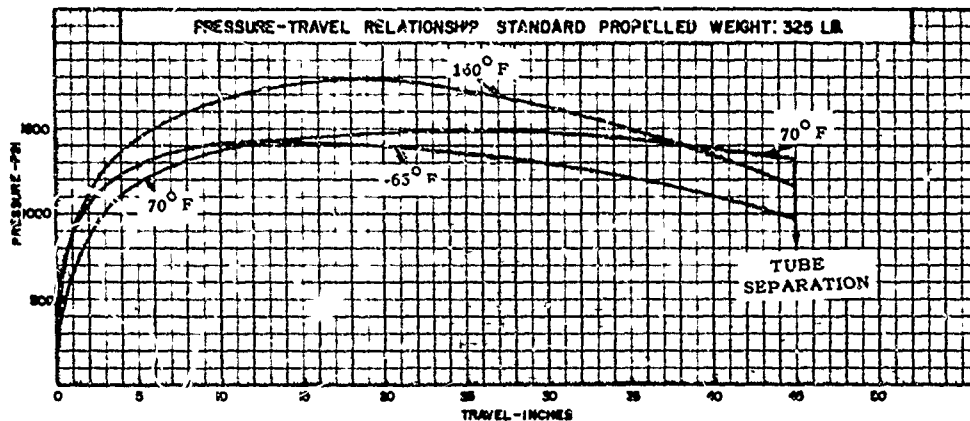
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M4A1



Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M4A1



Catapult

CATAPULT, AIRCRAFT EJECTION SEAT, M5A1

The M5A1 Catapult is a gas actuated three-tube telescoping device containing an explosive cartridge, designed to propel upward an ejection seat together with a crewman from high-speed aircraft to provide safe escape from disabled aircraft.

The catapult is approximately 39 inches long and 2.3 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the flexible hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer, thereby igniting the black powder and propellant in the M28A1 Cartridge. The catapult is unlocked by cam action as the firing pin moves toward the primer, unlocking the block assembly and inside tube. The catapult thrust which is developed from the expanding gases of the burning propellant forces the inside and telescoping tubes to move simultaneously until the shoulder on the telescoping tube comes in contact with the turnion, thus restricting its movement. The continuous moving block assembly and inside tube are ejected with the seat. The outside and telescoping tubes remain with the aircraft.

PRINCIPAL CHARACTERISTICS

Stroke	66.0 inches
Weight (total assy)	8.2 pounds
Propelled Weight	300.0 pounds
Temperature limits	--65°F to +160°F
Max Accel (at 70°F)	20.0 g
Velocity, min (at 70°F)	60.0 fps
Max rate of change of accel (at 70°F)	170.0 g/sec
Firing Method	Gas Actuation
Stroke Time (at 70°F)	0.220 sec

Catapult, Aircraft Ejection Seat, M5A1

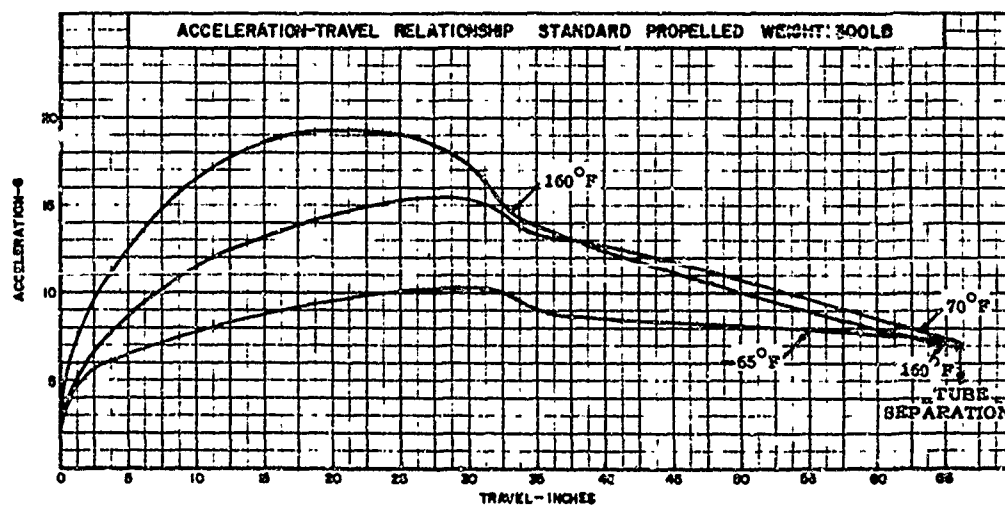
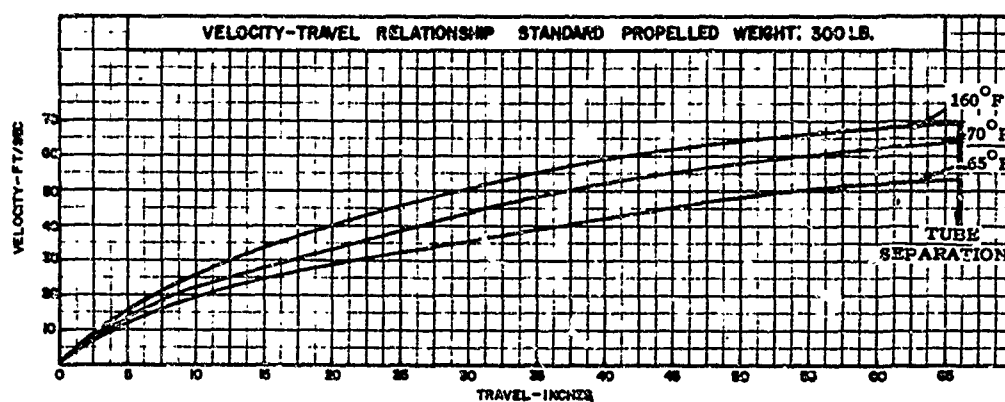
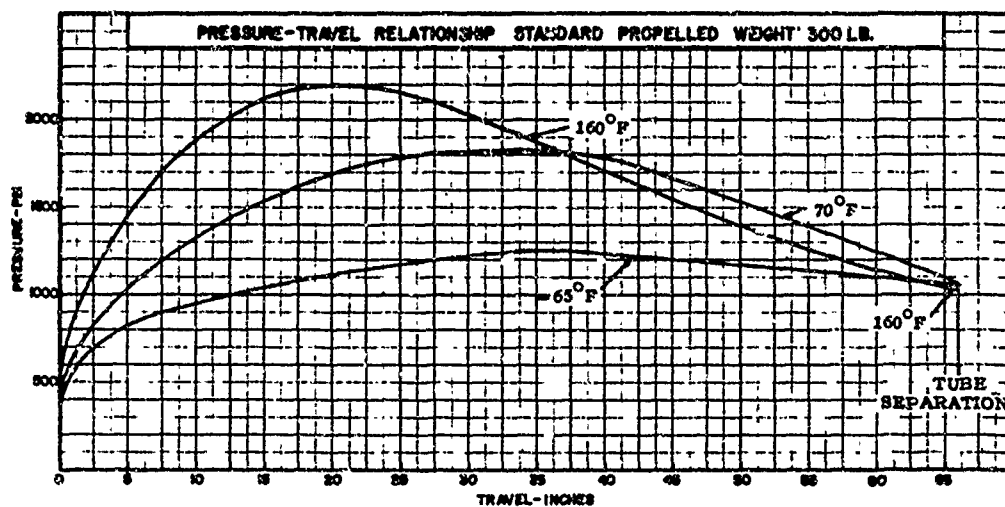


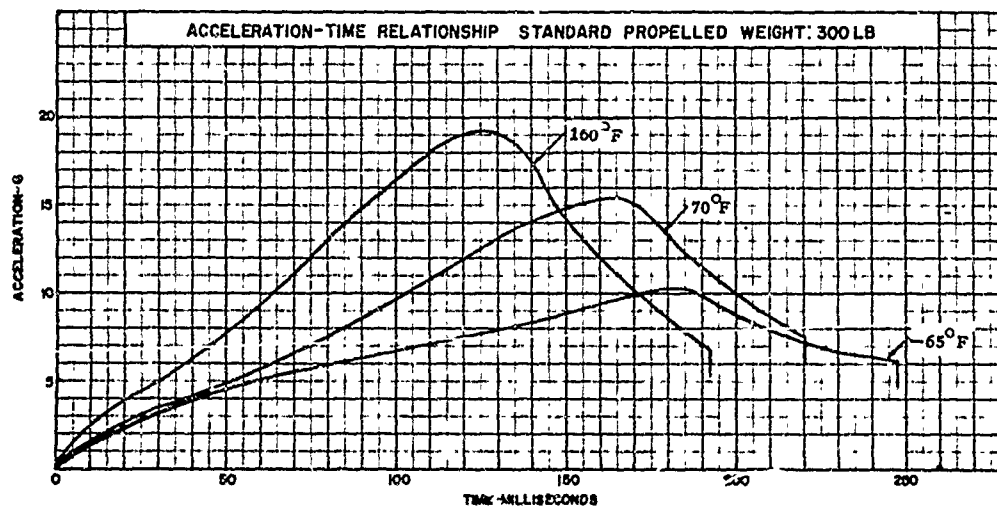
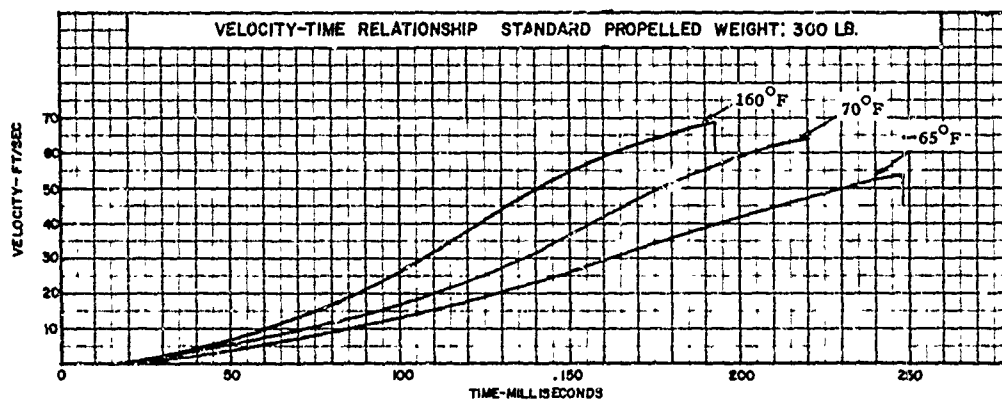
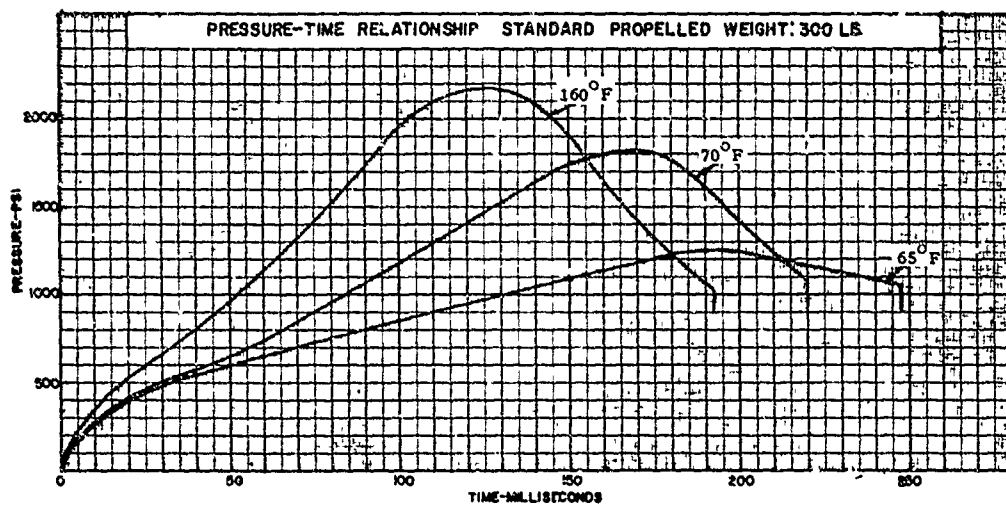
<u>Component</u>	<u>Component</u>
A Cap	J Pin, Shear
B Seal, Plain	K Ring, Stop & Pallet Assembly
C Tube, Outside & Pellet Assembly	L "O" Ring
D Tube, Telescoping	M Block
E Tube, Inside & Pellet Assembly	N Pipe Plug, Shipping
F Seal, Fixed	O Pin, Firing
G Trunnion	P Seal, Tamper Proof
H Washer, Shock	Q Latch (2)
I Screw, Cap, Socket Head, Self-Locking	R Plug
	S Cartridge, Aircraft Ejection Seat Catapult, M28A1
	T Seal, Plain



Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M5A1





Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, TRAINING, M6A1

The M6A1 Catapult with the Cartridge, Aircraft Ejection Seat Catapult, Training, M57 was designed to be used in the MH-15 Ejection Seat, Indoctrination Trainer (Mobile Type) for indoctrinating U. S. Air Force trainees in the catapult ejection procedures. In this application, the catapult ejects the seat and occupant along a guided track to about a height of 12 feet with moderate acceleration.

The training catapult is a two-tube, mechanically actuated, short stroke unit which is constructed of steel. The catapult is approximately 50.0 inches long. After actuation of the safety plate, the catapult is actuated by mechanical operation by the indoctrinee by means of a grip on the arm rest which is connected to the firing arm by a cable. Squeezing the grip rotates the firing arm and releases the spring loaded firing pin which strikes and detonates the primer, thereby igniting the black powder and propellant in the M57 Cartridge. The catapult thrust which is developed from the expanding gases of the burning propellant propels the seat and occupant up the tower. The inside tube and firing head assembly, which are attached to the seat, separate from the outside tube and are carried with the seat on ascent. The outside tube and its permanently attached parts remain in the cockpit of the trainer.

There are two safety systems connected to the catapult. The first system consisting of a plate prevents firing of the catapult inadvertently by the trainee, while the second prevents seat movement in the event of cartridge failure or other malfunctions. The latter safety system is accomplished by rotating the catapult outside tube through a cable locking system located on the trainer. This rotation causes the lugs of the bell cap located on top of the outside tube to engage corresponding protrusions inside the trunnion and securely locks both inner and outer tubes together.

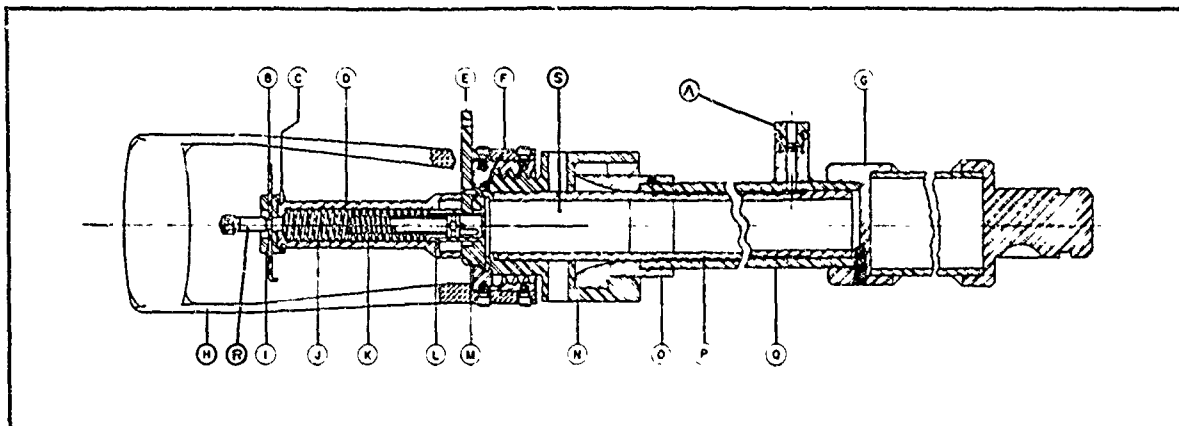
A ballistic safety valve assembly, incorporating a pre-bulged rupture disc, is attached to the lower end of the catapult outside tube and its purpose is to bleed off excessive gas pressure which might result in an excessive height of travel on the trainer.

PRINCIPAL CHARACTERISTICS

Stroke	21.0 inches
Weight (total Assembly)	31.5 pounds
Propelled weight	300.0 pounds
Temperature Limits	40°F to 125°F
Max accel (at 70°F)	8.5 g
Firing Method	Mechanical Actuation
Stroke Time (at 70°F)	0.163 sec

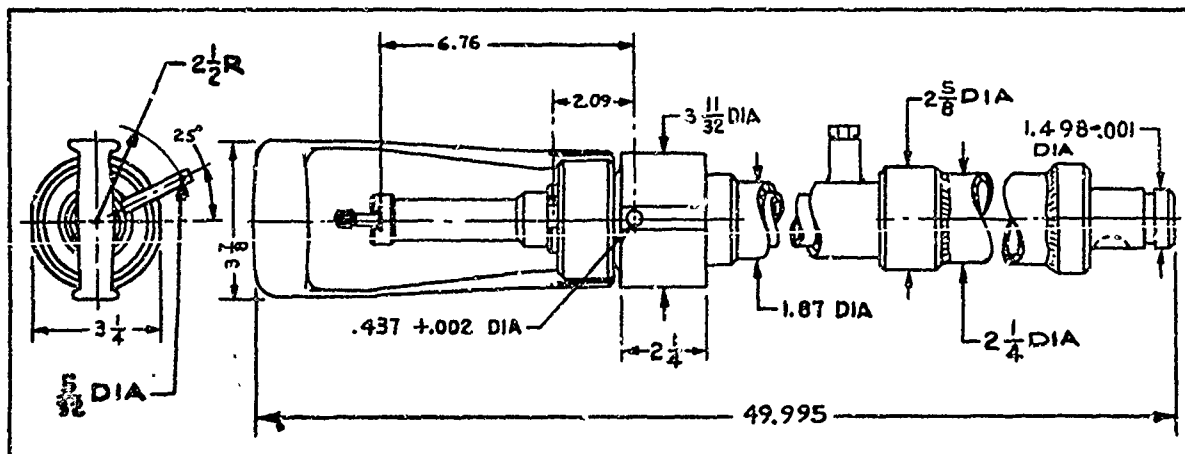
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, Training, M6A1



CROSS-SECTION DRAWING

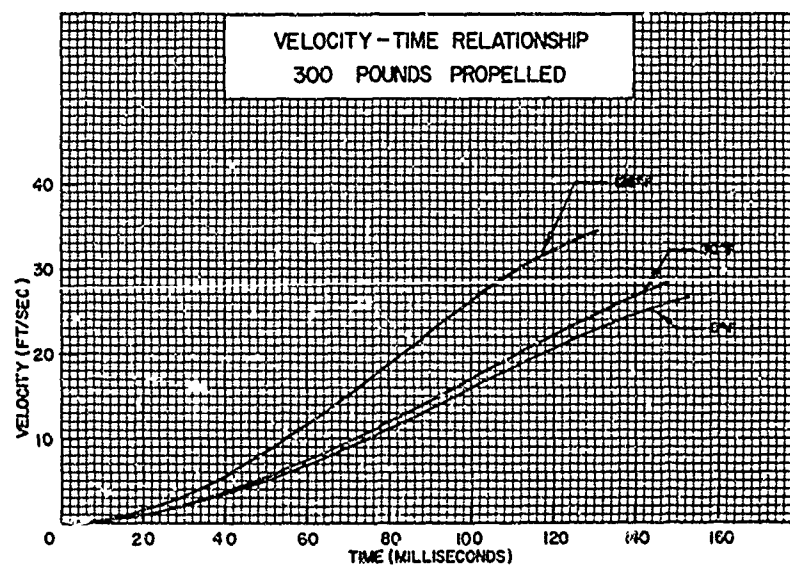
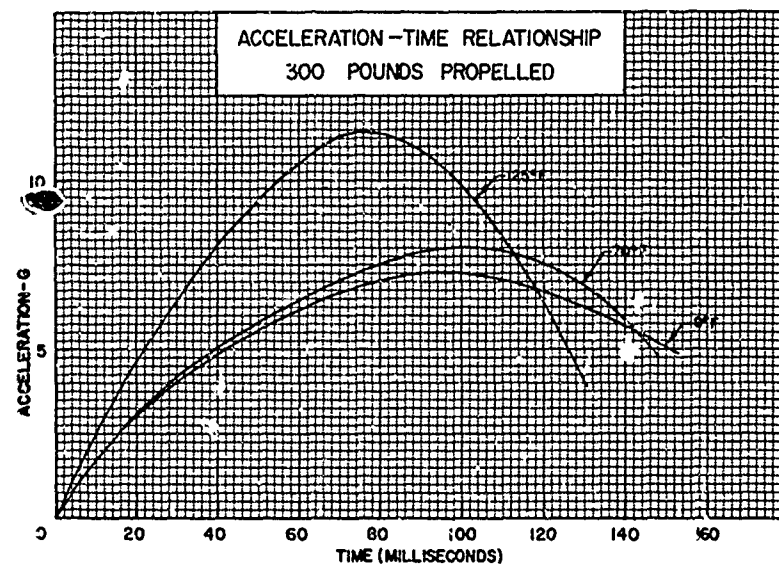
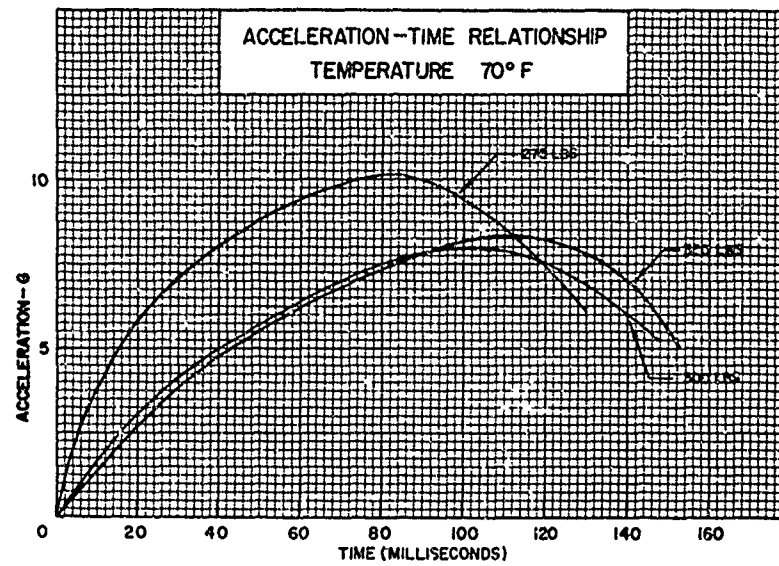
Component	Component
A Valve, Safety Assembly (shown out of position)	K Spring, Firing Pin
B Plate	L Ring, Sear
C Ring, Snap	M Body, Breech
D Cap, Breech	N Trunnion and Breech Ring Assembly
E Firing Arm Assembly	O Cap, Bell
F Ring, Snap, Retaining, Internal, Inverted Lug	P Tube, Inside
G Mount Assembly	Q Tube, Outside
H Handle	R Pin, Firing and Stop Assembly
I Slide	S Cartridge, Aircraft Ejection Seat, Catapult, M57 (Installed at Training Base)
J Spring, Sear, Ring	



ENVELOPE DRAWING

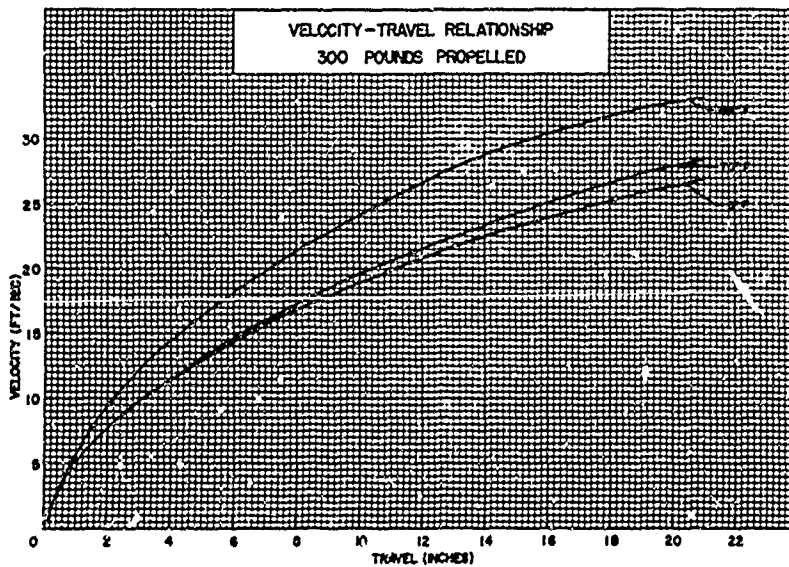
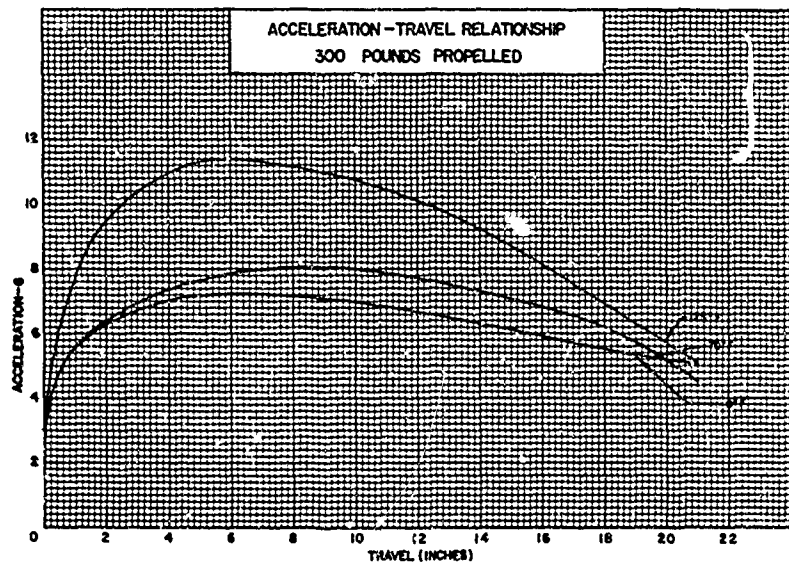
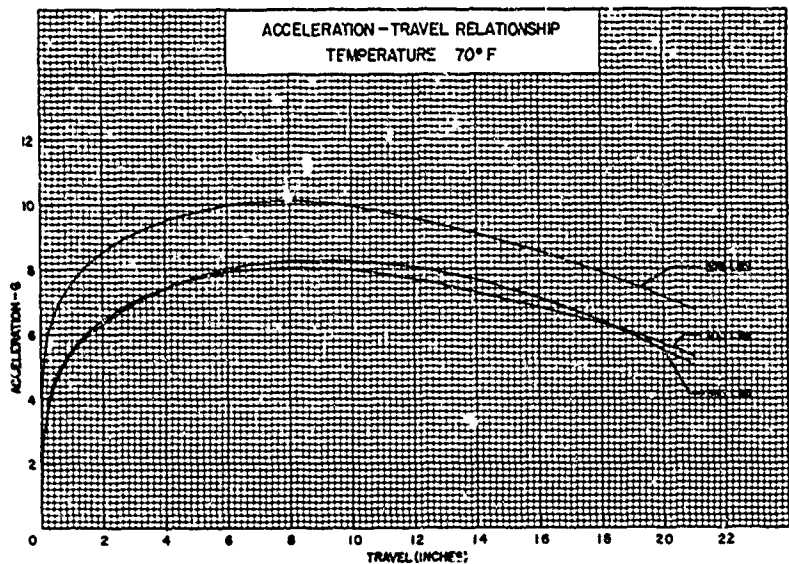
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, Training, M6A1



Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, Training, M6A1



Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, #8

The M8 Catapult is a rocket-assisted two tube telescoping device developed for use in the F105 Aircraft to provide "off-the-deck" as well as high speed ejection capability from disabled aircraft. The catapult is a two stage device; the initial booster phase and final rocket motor phase.

The catapult is approximately 46.3 inches long and 2.89 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer contained in the primary igniter. This action initiates the firing of the booster phase. The primer ignites the pyrotechnic composition contained in the igniter which flashes down the booster tube igniting the strip propellant bonded to the strip holder. The booster gas pressure moves the can, thereby permitting the tangs of the nozzle retainer to be cammed inward, unlocking the unit. Continued booster gas production propels the rocket motor and the seat vertically. At a point prior to motor tube separation, the cable, which is attached to the can, engages the cable guide on the strip holder assembly and forces the piston slider valve downward uncovering the gas by-pass ports on the cylinder booster tube assembly. This allows the hot booster gases to dump into the motor chamber which ignites the auxiliary igniter and the rocket propellant grain. The burning propellant grain produces gas at a high rate, pressurizing the motor chamber. This pressure forces out the nozzle cups allowing the gas to exhaust through the nozzle ports, thus providing thrust which propels the seat and occupant upward and forward. The nozzle is caned 37°30', so as to direct the rocket thrust through the center of gravity of the seat-man combination.

PRINCIPAL CHARACTERISTICS

Weight (total assembly)	27.0 lbs.
Propelled Weight	350.0 lbs.
Temperature Limits	-65° to +160°F

Catapult (Booster Section)

Stroke	40 inches
Max Acceleration (at 70°F)	20.0 g
Velocity (at 70°F)	40.0 fps
Max Rate of Change of Acceleration (at 70°F)	300.0 g/sec
Stroke Time (at 70°F)	0.175 sec
Firing Method	Gas Actuation

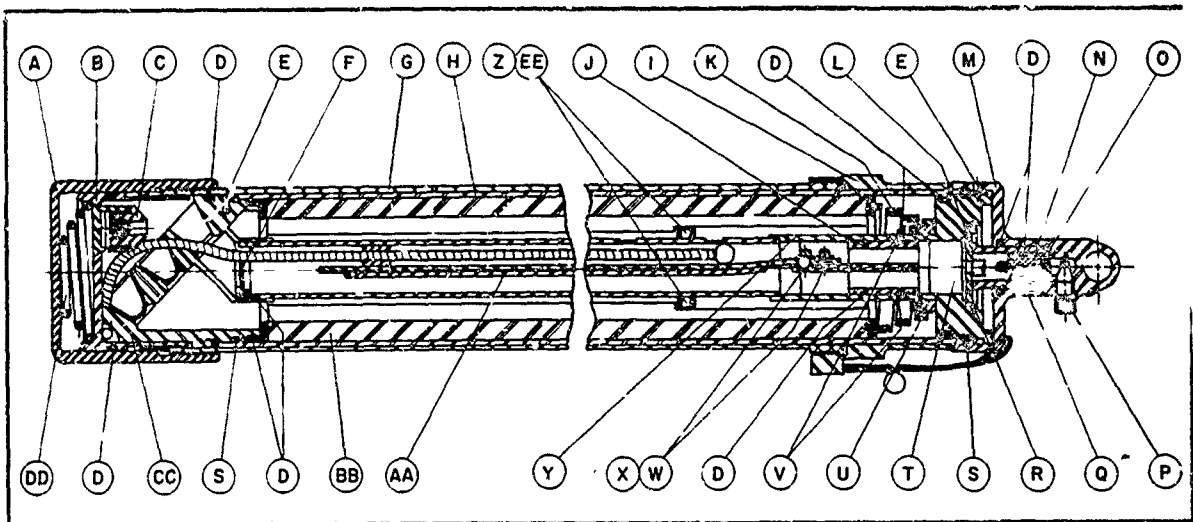
Catapults

PRINCIPAL CHARACTERISTICS (M8 Cont'd)

Rocket (Sustainer Section)

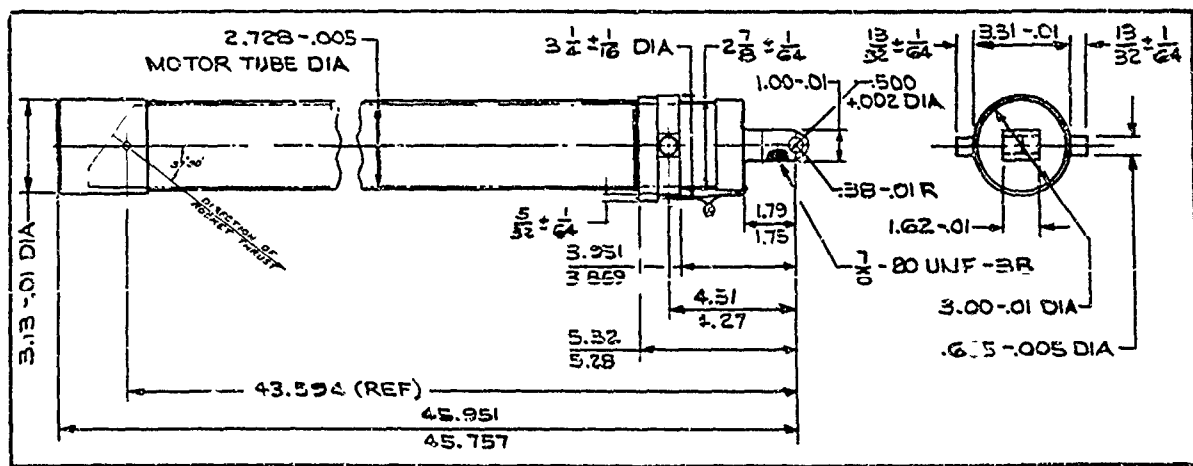
Action Time, max (at 70°F)	0.400 sec.
Impulse (resultant at 70°F)	1200 lb-sec.
Pressure, max	4600 psi.
Ignition Delay, max (at 70°F)	0.012 sec.
Nozzle Angle	37°30'

Catapult, Aircraft Ejection Seat, M8



CROSS-SECTION DRAWING

Component	Component
A Breech, Launcher	P Plug, Shipping
B Can, Bottom	Q Sleeve, Firing Pin
C Holder, Cable Lower	R Ring, Retaining
D "O" Ring	S Wire, Lock
E Screw, Set	T Igniter, Primary Assembly
F Plate, Orifice	U Igniter, Auxiliary Assembly
G Tube, Launcher And Peilet Assembly	V Pin, Valve Shear (4)
H Tube, Motor	W Screw (2)
I Trunnion	X Washer (2)
J Piston, Slider Valve	Y Cylinder, Slider Valve And Tube Booster Assembly
K Spring, Grain	Z Collar, Grain
L Cap, Igniter	AA Holder, Strip, Loaded Assembly
M Head, Motor Tube	BB Propellant, Grain Inhibited
N Pin, Firing	CC Nozzle Assembly
O Pin, Shear	DD Spring, Can
	EE Screw, Set (4)



ENVELOPE DRAWING

Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, M9

The M9 Catapult is a rocket-assisted two tube telescoping device developed for use in the T-38 Aircraft to provide "off-the-deck" as well as high speed ejection capability from disabled aircraft. The catapult is a two-stage device; the initial booster phase and final rocket motor phase.

The catapult is approximately 41.9 inches long and 2.89 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer contained in the primary igniter. This action initiates the firing of the booster phase. The primer ignites the pyrotechnic composition contained in the igniter which flashes down the booster tube igniting the strip propellant bonded to the strip holder. The booster gas pressure moves the can, thereby permitting the tangs of the nozzle retainer to be cammed inward, unlocking the unit. Continued booster gas production propels the rocket motor and the seat vertically. At a point prior to motor tube separation, the cable, which is attached to the can, engages the cable guide on the strip holder assembly and forces the piston slider valve downward uncovering the gas by-pass ports on the cylinder booster tube assembly. This allows the hot booster gases to dump into the motor chamber which ignites the auxiliary igniter and the rocket propellant grain. The burning propellant grain produces gas at a high rate, pressurizing the motor chamber. This pressure forces out the nozzle cups allowing the gas to exhaust through the nozzle ports, thus providing thrust which propels the seat and occupant upward and forward. The nozzle is canted $47^{\circ} 30'$, so as to direct the rocket thrust through the center of gravity of the seat-man combination.

PRINCIPAL CHARACTERISTICS

Weight (total Assembly)	24.0 lbs.
Propelled Weight	350 lbs.
Temperature Limits	-65°F to $+160^{\circ}\text{F}$

Catapult (Booster Section)

Stroke	35-3/4 inches
Max Accel. (at 70°F)	20.0 g
Velocity (at 70°F)	40.0 fps
Max. Rate of Change of Accel. (at 70°F)	300 g/sec
Stroke Time (at 70°F)	0.160 sec
Firing Method	Gas Actuation

Propellant Actuated Devices

Catapults

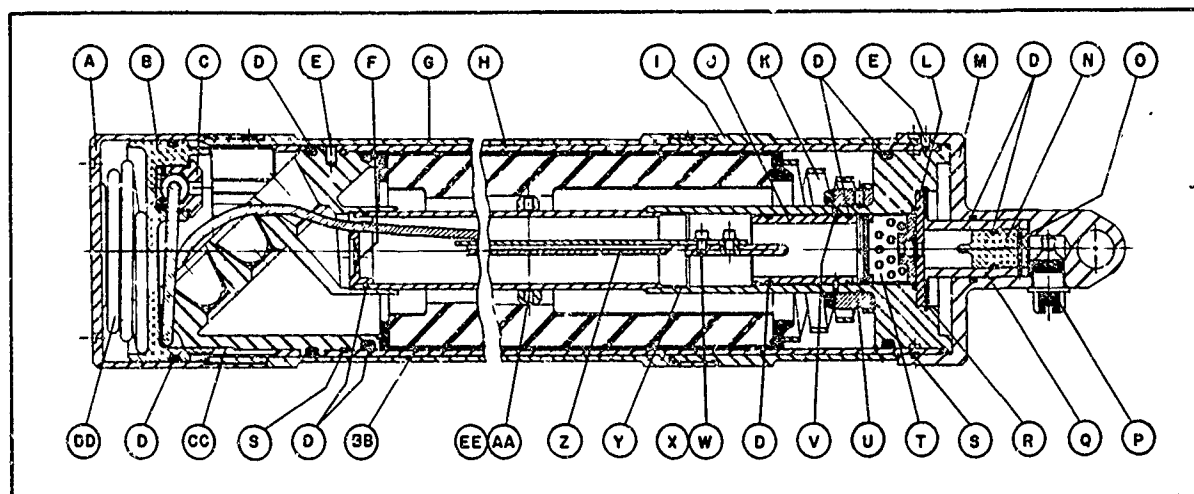
PRINCIPAL CHARACTERISTICS (M9 Cont'd)

Rocket (Sustainer Section)

Action Time, max (at 70°F)	0.350 sec
Impulse (resultant at 70°F)	1100 lb-sec
Pressure, max	4600 psi
Ignition Delay, max (at 70°F)	0.012 sec
Nozzle Angle	47°30'

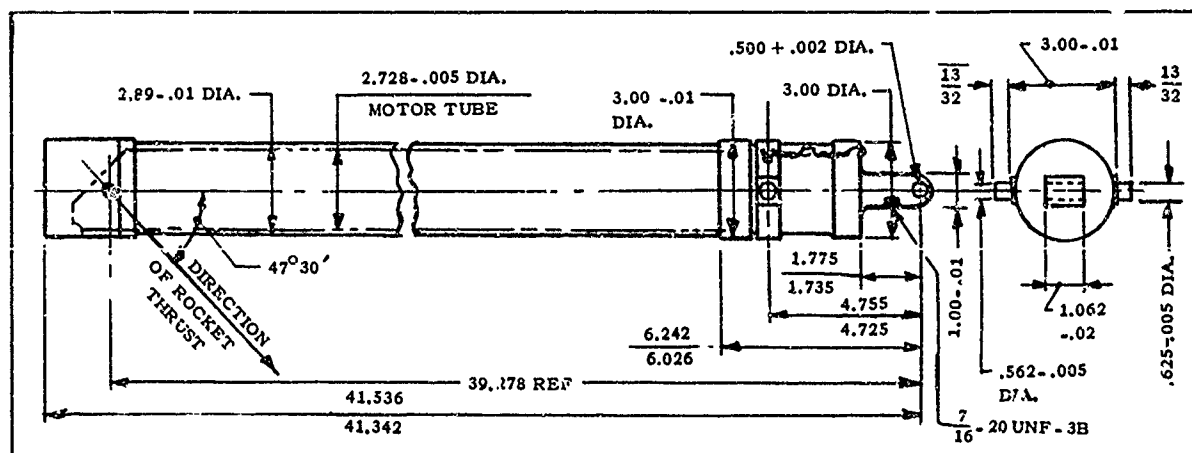
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M9



CROSS-SECTION DRAWING

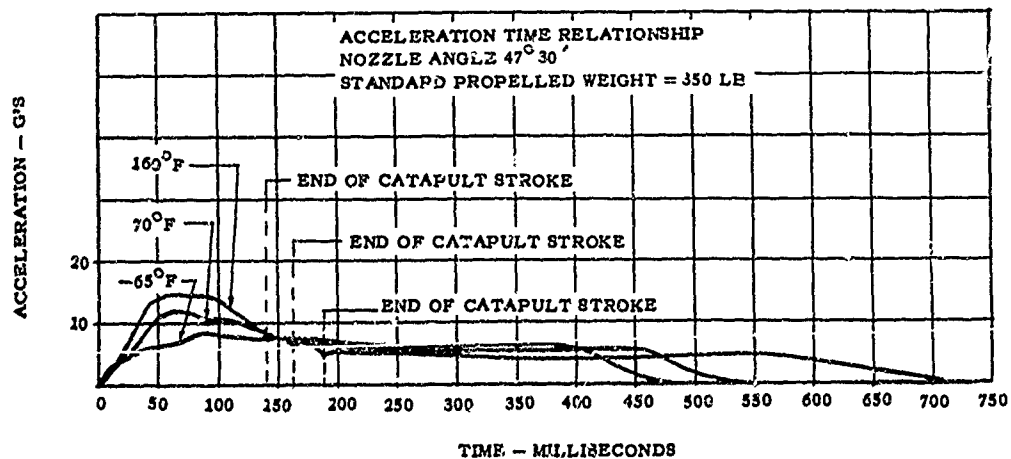
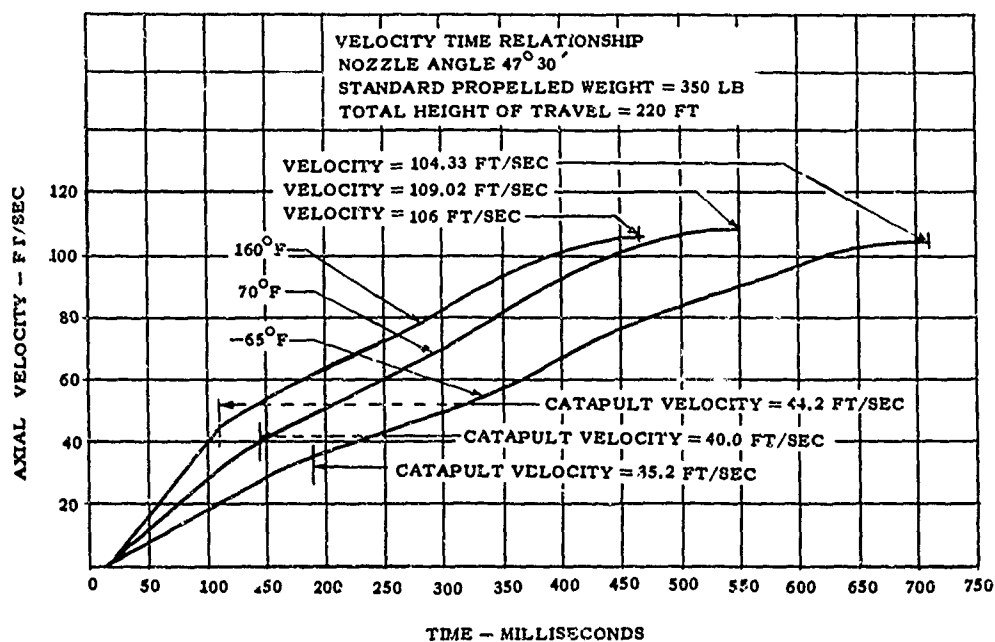
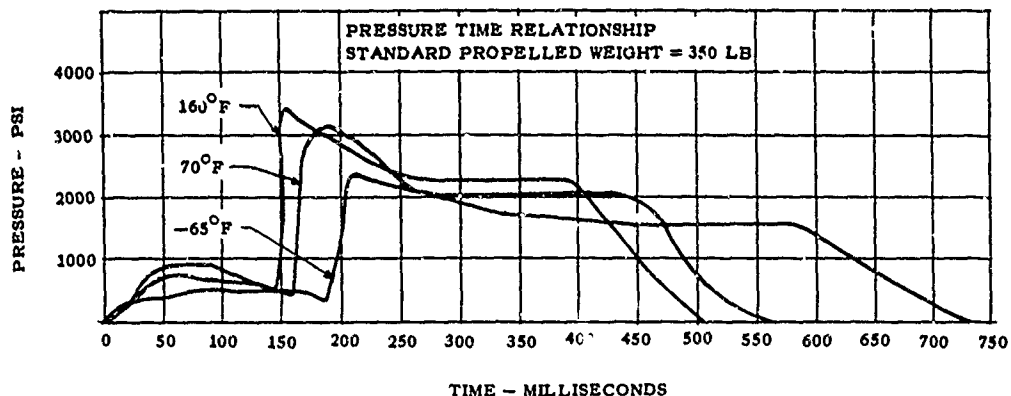
Component	Component
A Breech, Launcher	P Plug, Shipping
B Can, Bottom	Q Sleeve, Firing Pin
C Holder, Cable Lower	R Ring, Retaining
D "O" Ring	S Wire, Lock
E Screw, Set	T Igniter, Primary Assembly
F Plate, Orifice	U Igniter, Auxiliary Assembly
G Tube, Launcher And Pellet Assembly	V Pin, Valve Shear (4)
H Tube, Motor	W Screw (2)
I Trunnion And Pellet Assembly	X Washer (2)
J Piston, Slider Valve	Y Cylinder, Slider Valve And Tube Booster Assembly
K Spring, Grain	Z Holder, Strip, Loaded Assembly
L Cap, Igniter	AA Collar, Grain
M Head, Motor Tube	BB Propellant, Grain Inhibited
N Pin, Firing	CC Nozzle Assembly
O Pin, Shear	DD Spring, Can
	EE Screw, Set (4)



ENVELOPE DRAWING

Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M9



Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, M10

The M10 Catapult is a rocket-assisted two tube telescoping device developed for use in the F104 Aircraft to provide "off-the-deck" as well as high speed ejection capability from disabled aircraft. The catapult is a two stage device; the initial booster phase and final rocket motor phase.

The catapult is approximately 44.1 inches long and 2.89 inches in diameter. The catapult has an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer contained in the primary igniter. This action initiates the firing of the booster phase. The primer ignites the pyrotechnic composition contained in the igniter which flashes down the booster tube igniting the strip propellant bonded to the strip holder. The booster gas pressure moves the can, thereby permitting the tangs of the nozzle retainer to be cammed inward, unlocking the unit. Continued booster gas production propels the rocket motor and the seat vertically. At a point prior to motor tube separation the cable, which is attached to the can, engages the cable guide on the strip holder assembly and forces the piston slider valve downward uncovering the gas by-pass ports on the cylinder booster tube assembly. This allows the hot booster gases to dump into the motor chamber which ignite the auxiliary igniter and the rocket propellant grain. The burning propellant grain produces gas at a high rate, pressurizing the motor chamber. This pressure forces out the nozzle cups allowing the gas to exhaust through the nozzle ports, thus providing thrust which propels the seat and occupant upward and forward. The nozzle is canted 36°20', so as to direct the rocket thrust through the center of gravity of the seat-man combination.

PRINCIPAL CHARACTERISTICS

Weight (Total Assy)	26.0 pounds
Propelled Weight	400.0 pounds
Temperature Limits	-65°F to +160°F

Catapult (Booster Section)

Stroke	34.0 inches
Max. Acceleration (at 70°F)	20.0 g
Velocity (at 70°F)	40.0 fps
Max. Rate of Change of Acceleration (at 70°F)	350.0 g/sec
Stroke time (at 70°F)	0.155 sec
Firing Method	Gas Actuation

Propellant Actuated Devices

Catapults

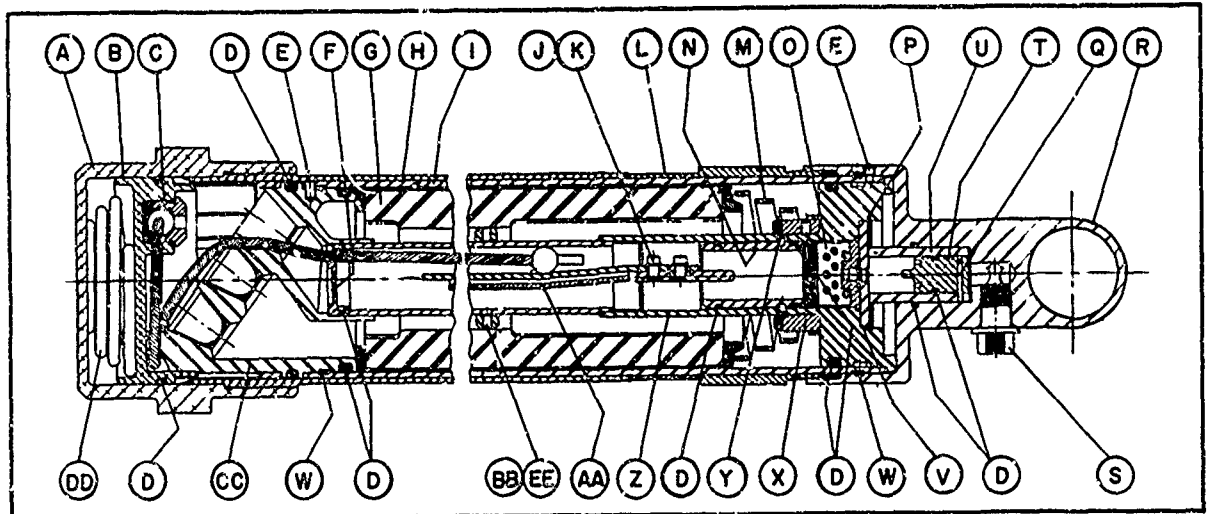
PRINCIPAL CHARACTERISTICS (M10 Cont'd)

Rocket (Sustainer Section)

Action Time, max. (at 70°F)	0.400 sec
Impulse (resultant, at 70°F)	1100 lb-sec
Pressure, max.	4600 psi
Ignition Delay, max. (at 70°F)	0.012 sec
Nozzle Angle	36° 20'

Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M10



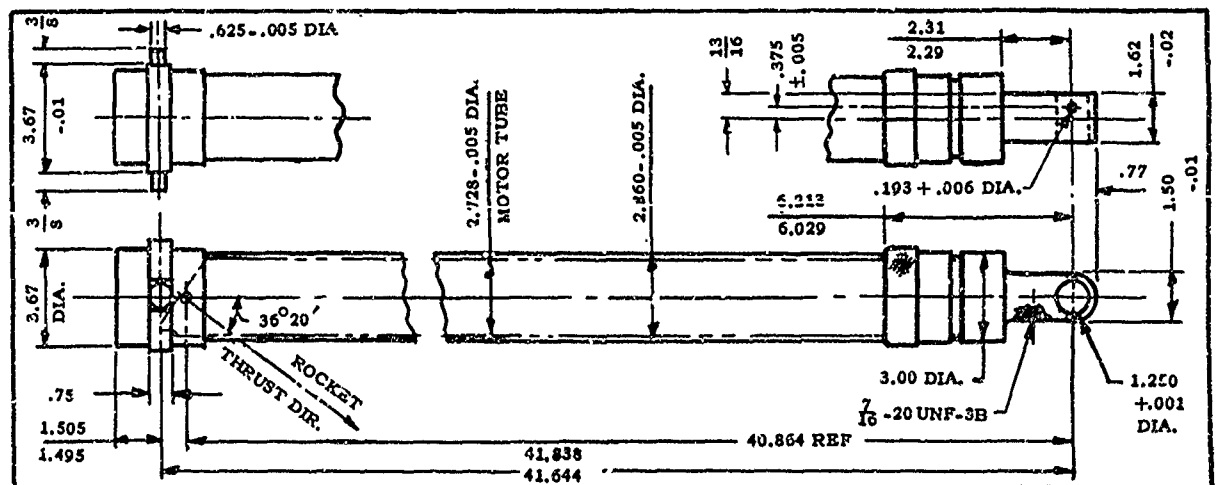
CROSS-SECTION DRAWING

Component

- A Breech, Launcher Trunnion
- B Can, Bottom
- C Holder, Cable Lower
- D "O" Ring
- E Screw, Set
- F Plate, Orifice
- G Propellant Grain, Inhibited
- H Tube, Launcher
- I Tube, Motor
- J Screw (2)
- K Washer (2)
- L Sleeve, Head
- M Spring, Grain
- N Piston, Slider Valve
- O Igniter, Primary Assembly
- P Ring, Retaining

Component

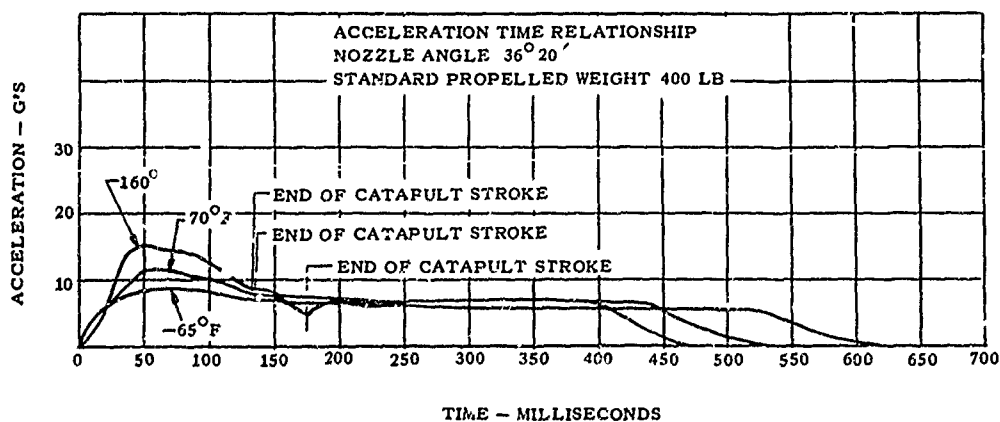
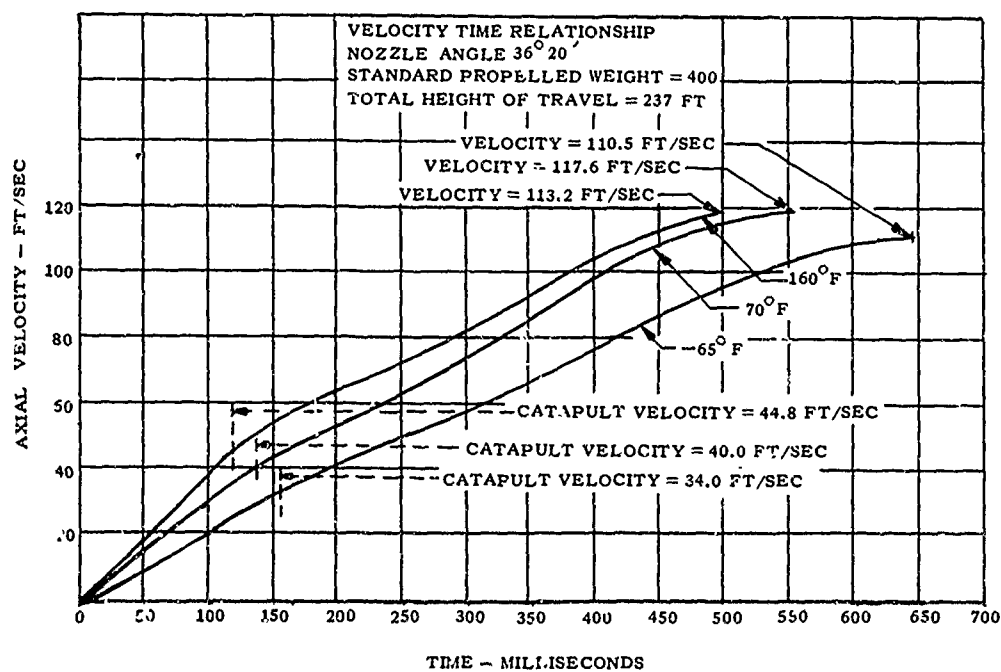
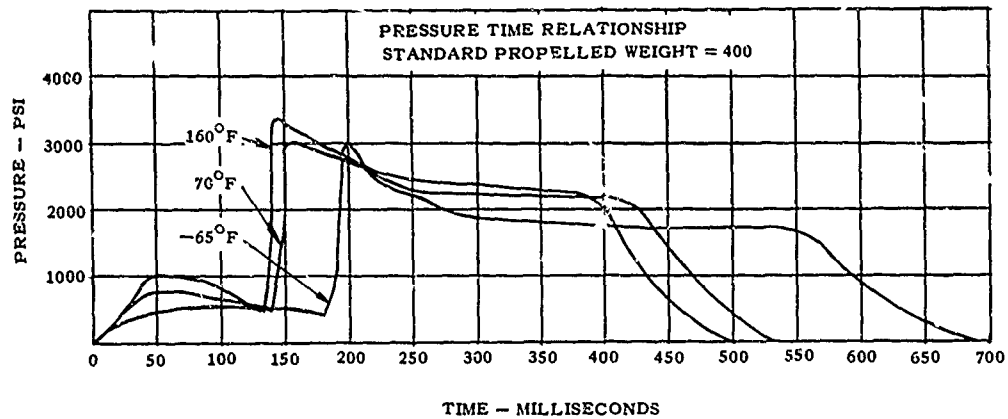
- Q Pin, Shear
- R Head, Motor Tube
- S Plug, Shipping
- T Pin, Firing
- U Sleeve, Firing Pin
- V Cap, Igniter Retaining
- W Wire, Lock
- X Igniter, Auxiliary Assembly
- Y Pin, Valve, Shear (4)
- Z Cylinder, Slider Valve And Tube Booster Assembly
- AA Holder, Strip Loaded Assembly
- BB Collar, Grain
- CC Nozzle Assembly
- DD Spring, Can
- EE Screw Set (4)



ENVELOPE DRAWING

Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, M10



Catapults

CATAPULT, AIRCRAFT EJECTION SEAT, XM38

The XM38 catapult is a rocket-assisted two-tube telescoping device developed as a replacement for the M9 catapult currently installed in the F5/T38 aircraft. The catapult is a two-stage device; the initial booster phase and final rocket motor phase.

The catapult is approximately 42.6 inches long and 3.125 inches in diameter. The catapult is ignited by an initiator attached by a length of flexible hose. When the initiator is functioned, the gas developed flows through the hose, exerting force against the catapult firing pin. The firing pin is propelled forward and strikes and detonates the primer contained in the booster cartridge. This action initiates the firing of the booster phase. The primer ignites the propellant charge contained in the cartridge. The booster tube gas pressure moves a piston, thereby permitting locking keys to be cammed inward, unlocking the unit. Continued booster gas production propels the rocket motor and the seat vertically. At the point of booster tube separation, the hot booster gases are introduced into the motor chamber and ignite the rocket propellant grain. The burning propellant grain produces gas at a high rate, pressurizing the motor chamber. The resulting pressure acts on a piston which rotates the nozzle to a preset position, thus providing thrust which propels the seat and occupant upward and forward. The nozzle angle which is controlled by seat position is adjustable from 39 degrees to 52 degrees so as to direct the rocket thrust through the center of gravity of the seat-man combination.

PRINCIPAL CHARACTERISTICS

Weight (total assembly)	33.0 pounds
Propelled Weight	383 pounds (50 percentile man)
Temperature Limits	-65° F to + 165° F

Catapult (Booster Section)

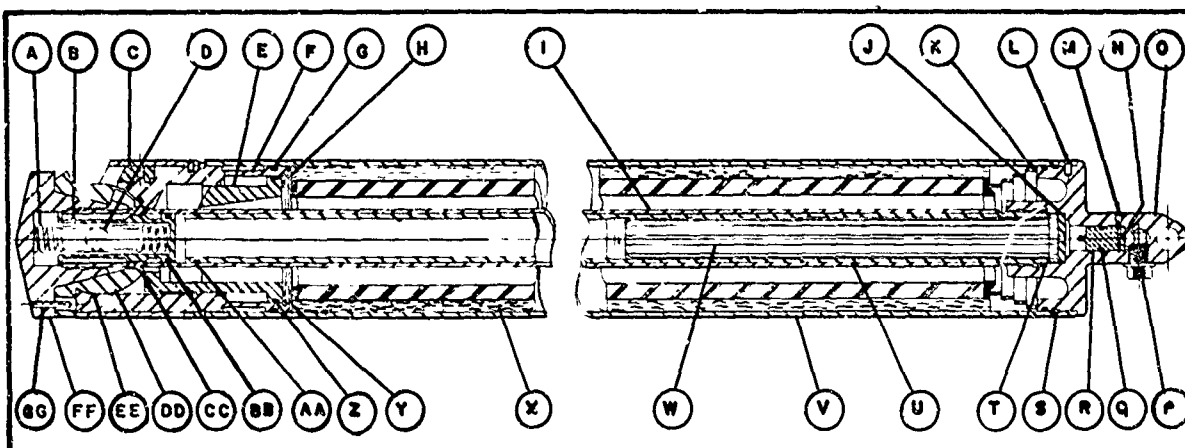
Stroke	34 inches
Max Acceleration (at 70° F)	18 g
Velocity (at 70° F)	47 fps
Max Rate of Change of Acceleration (at 70° F)	300 g/sec
Stroke Time (at 70° F)	.170 sec
Firing Method	Gas Actuation

Rocket (Sustain Section)

Action Time, max (at 70° F)	.410 sec
Impulse (resultant at 70° F)	1250 lb-sec
Pressure, average	3200 psi
Ignition Delay, max (at 70° F)	.025 sec
Nozzle Angle Adjustment Range	39° to 52°

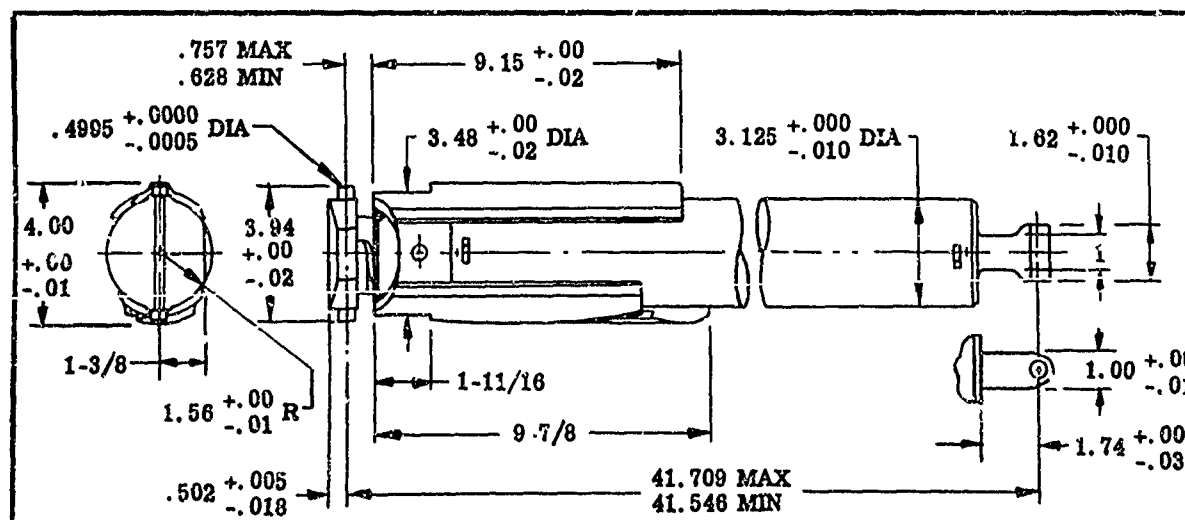
Propellant Actuated Devices

Catapult, Aircraft Ejection Seat, XM38

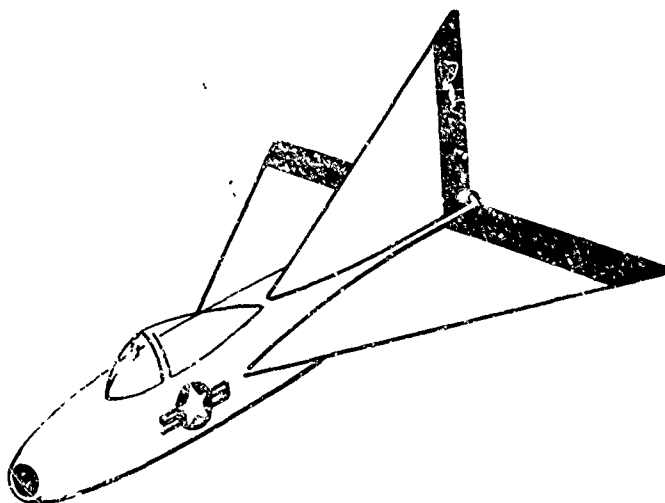


CROSS-SECTION DRAWING

Component	Component
A Spring, Locking	R Pin, Firing
B Release	S Wire, Lock (2)
C Cam	T "O" Ring
D Lug (2)	U Tube, Booster
E Sleeve	V Tube, Motor
F Retainer	W Cartridge, Impulse, XM270, Assembly
G "O" Ring (2)	X Propellant, Grain Inhibited
H Washer	Y Ring, Retainer
I Tube, Launcher	Z "O" Ring
J Plate	AA "O" Ring
K Spring, Grain	BB "O" Ring
L Screw	CC Key
M Screw	DD Nozzle
N Pin, Shear	EE "O" Ring (2)
O Head	FF Mount
P Plug, Shipping	GG Spring Pin
Q "O" Ring	



ENVELOPE DRAWING



SECTION IV

INITIATORS

Initiators

INTRODUCTION

Description:

An initiator is an actuating energy source for the operation of the firing mechanisms of other propellant actuated device components of aircrew escape systems. It is a cylindrical device consisting of a chamber with a pressure outlet port, a firing mechanism and a cartridge.

Initiator devices are classified in accordance with the following characteristics:

- (1) Method of Actuation – mechanical or gas pressure; (2) Function Time – nondelay or delay; and (3) Performance – low or high pressure energy.

Operation:

Actuation of the mechanical initiator is accomplished by an axial load application to the initiator pin. The firing pin, which is locked to the initiator pin with steel balls, compresses the spring enclosed in the firing pin housing and initiator cap, upon initiator pin withdrawal. When the firing pin enters the relieved section of the spring enclosure, the balls move outward, disengaging the initiator pin which is withdrawn from the device. The released firing pin is then propelled against the cartridge percussion primer by the exerted force of the compressed spring.

Actuation of the gas-fired initiator is accomplished when gas pressure, supplied by another propellant actuated device is introduced into the initiator inlet port, exerting a force against the firing pin which is retained in position by a shear pin. The resultant force application, causing shearing of the pin, propels the firing pin against the cartridge percussion primer.

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M3A1C

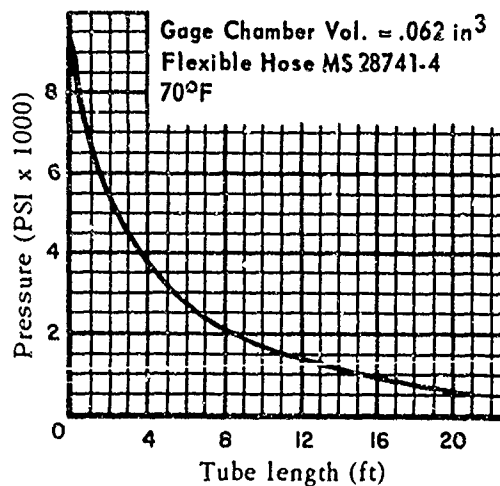
The M3A1C Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M73 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

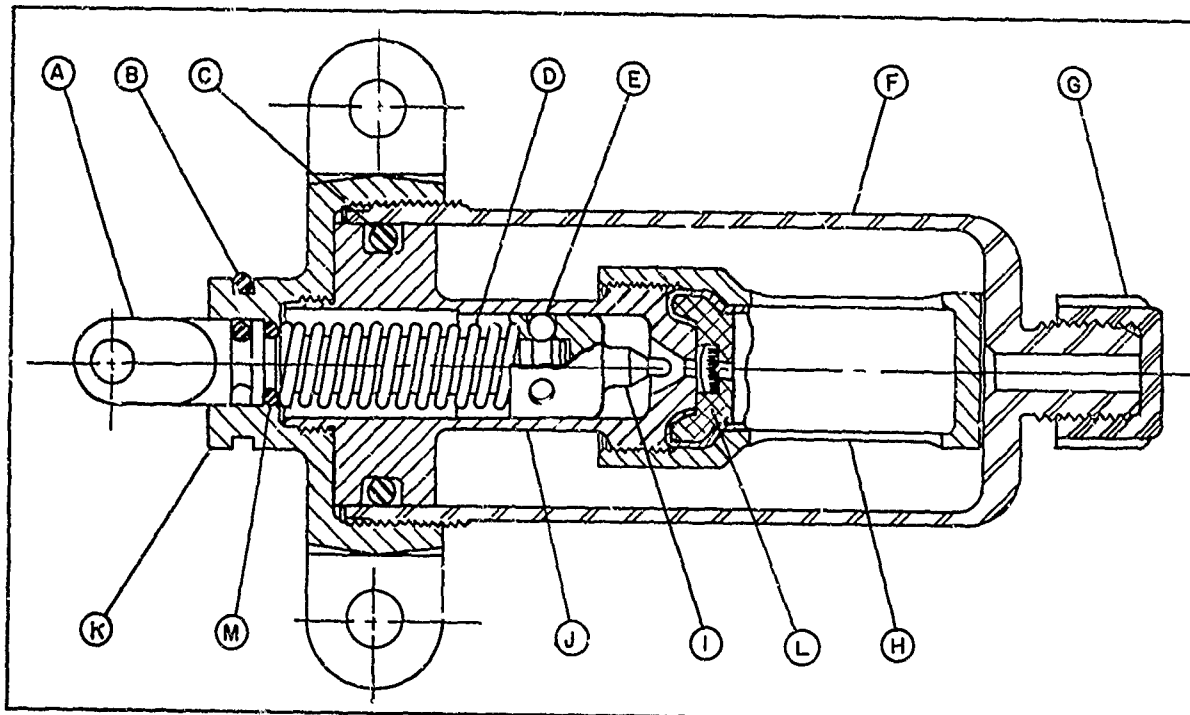
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



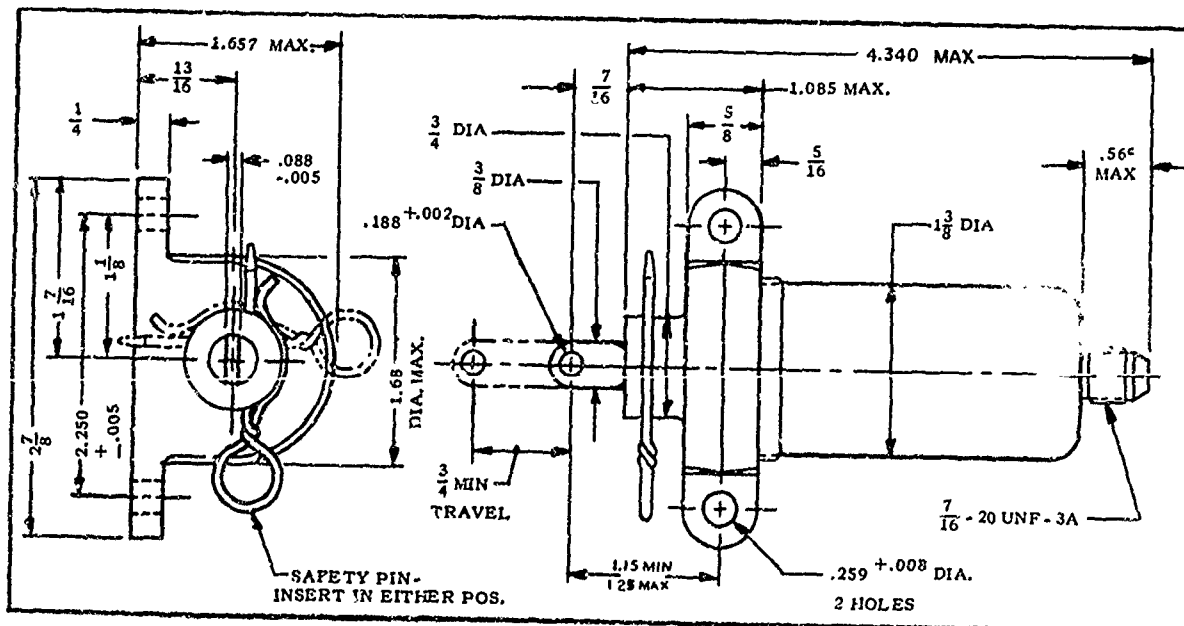
Propellant Actuated Devices

Initiator, Cartridge Actuated, M3A1C



CROSS-SECTION DRAWING

Component	Component
A Pin, Initiator	G Cap, Shipping
B Pin, Safety	H Retainer, Cartridge
C "O" Ring	I Pin, Firing
D Spring, Initiator	J Housing, Firing Pin
E Balls (3)	K Cap, Initiator
F Chamber, Initiator	L Cartridge, Initiator, M73 Assembly
	M Seal



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M3A2

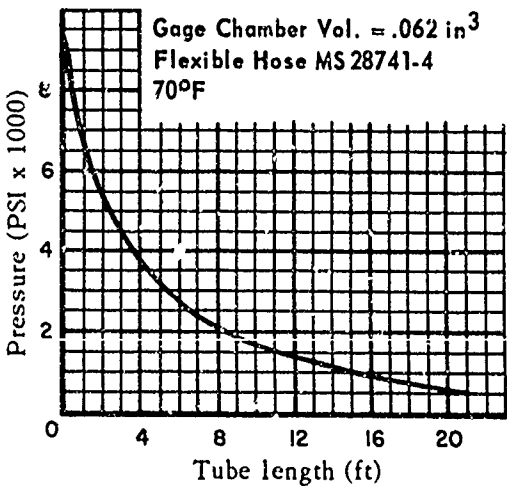
The M3A2 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M73 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

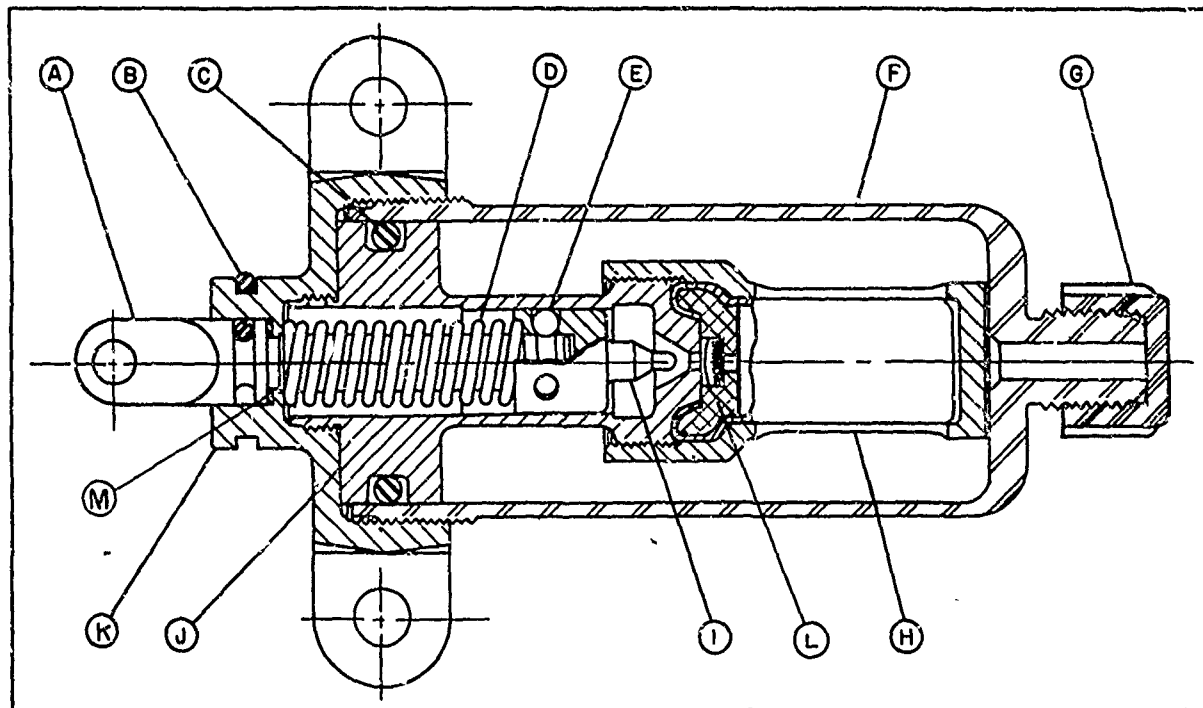
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



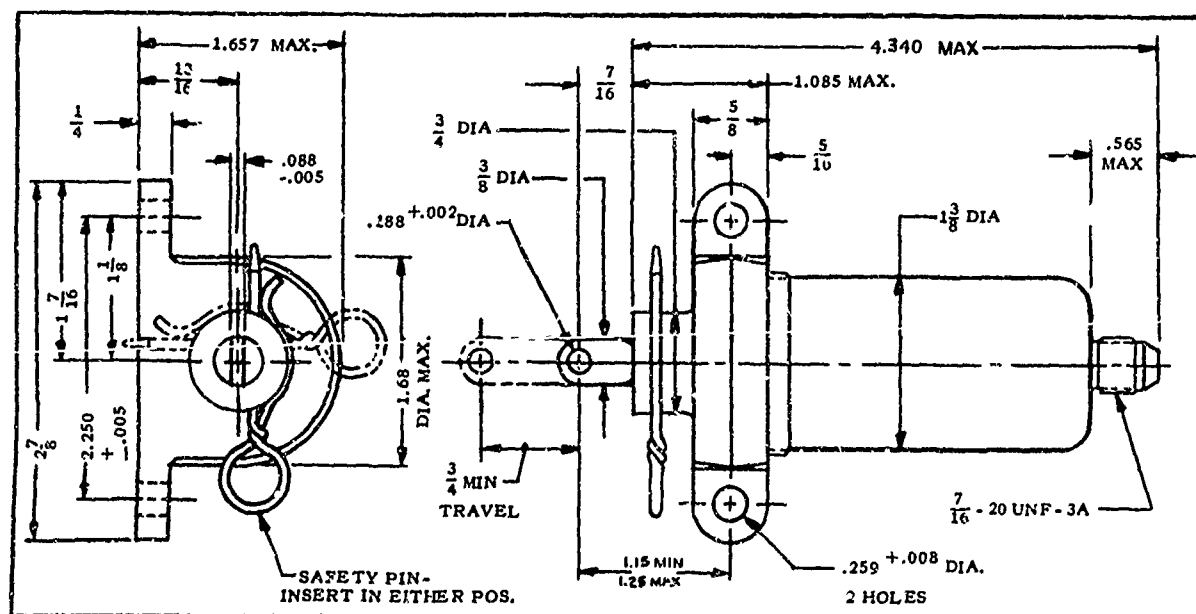
Propellant Actuated Devices

Initiator, Cartridge Actuated, M3A2



CROSS-SECTION DRAWING

Component	Component
A Pin, Initiator	G Cap, Shipping
B Pin, Safety	H Retainer, Cartridge
C "O" Ring	I Pin, Firing
D Spring, Initiator	J Housing, Firing Pin
E Ball	K Cap, Initiator
F Chamber, Initiator	L Cartridge, Initiator, M73 Assembly
	M Seal



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR CARTRIDGE ACTUATED, DELAY, M4A1

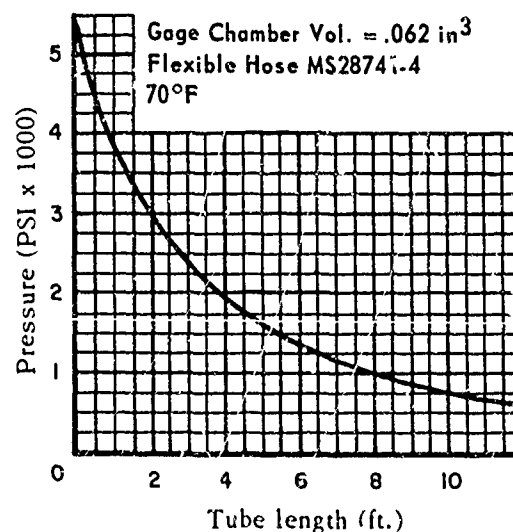
The M4A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M46 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

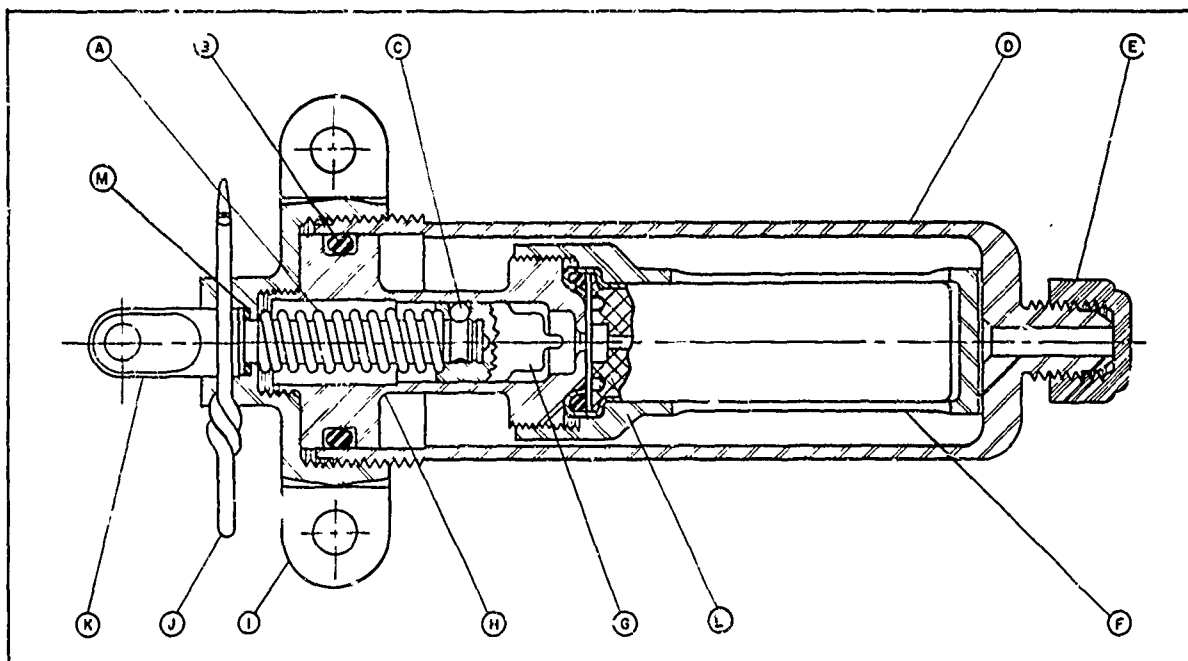
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	2.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE

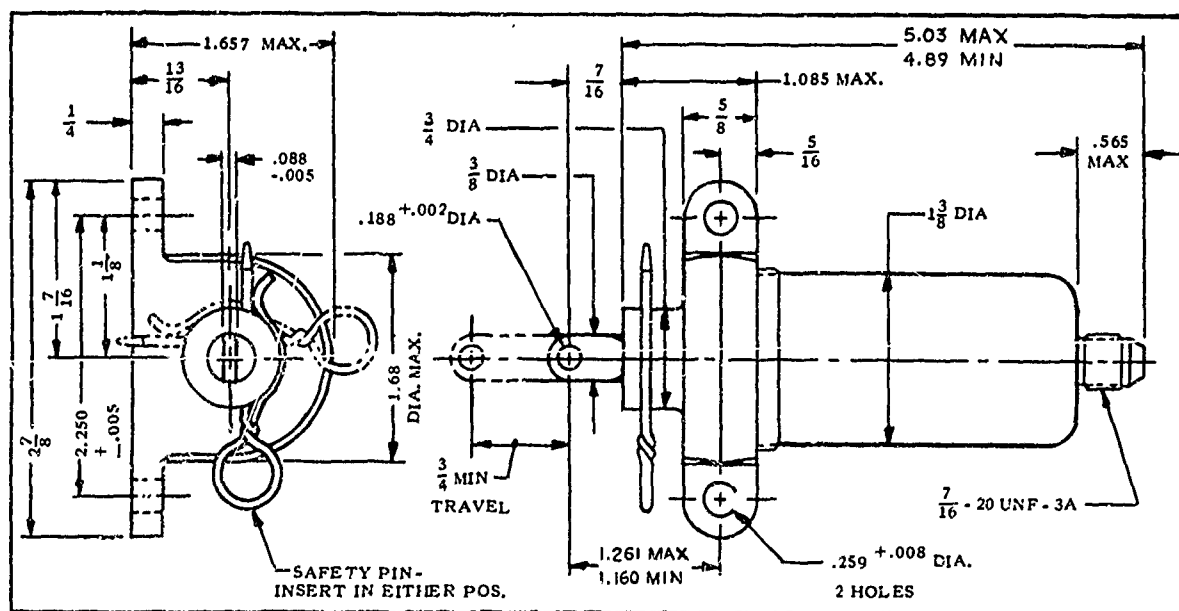


Initiator, Cartridge Actuated, Delay, M4A1



CROSS-SECTION DRAWING

<u>Component</u>	<u>Component</u>
A Spring, Initiator	H Housing, Firing Pin
B "O" Ring	I Cap
C Bail	J Pin, Safety
D Chamber, Initiator	K Pin, Initiator
E Cap, Shipping	L Cartridge, Initiator, Delay M46 Assembly
F Retainer, Cartridge	M Seal
G Pin, Firing	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M5A2

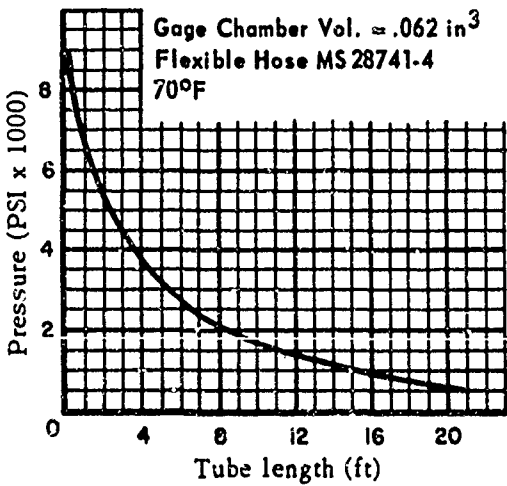
The M5A2 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M73 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

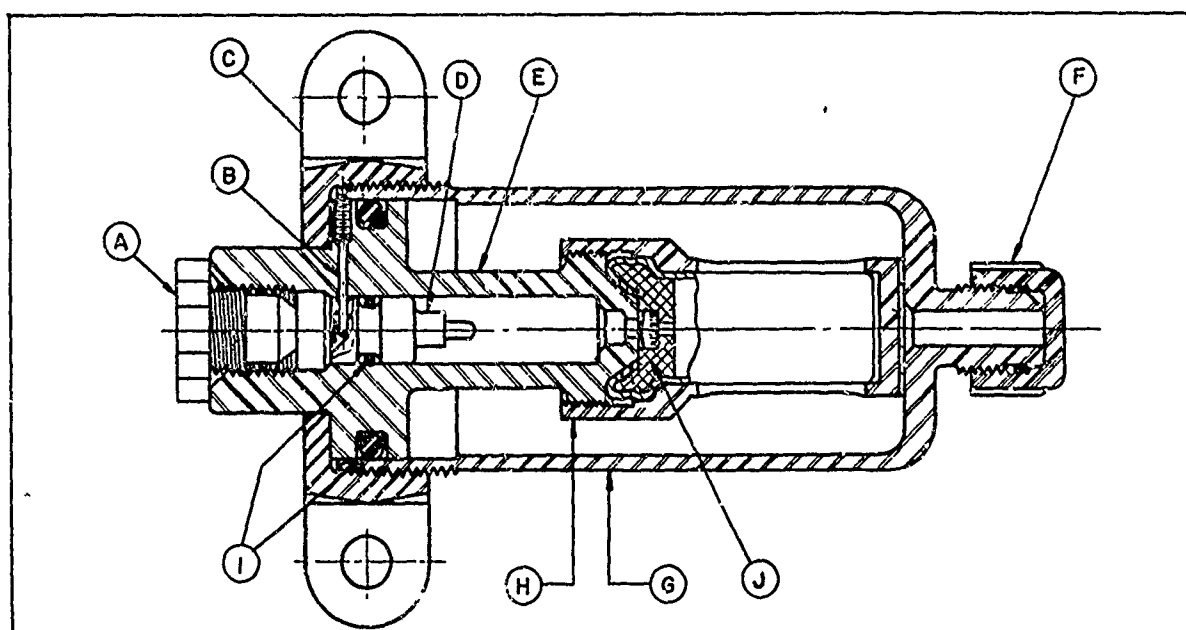
Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.

TYPICAL PERFORMANCE



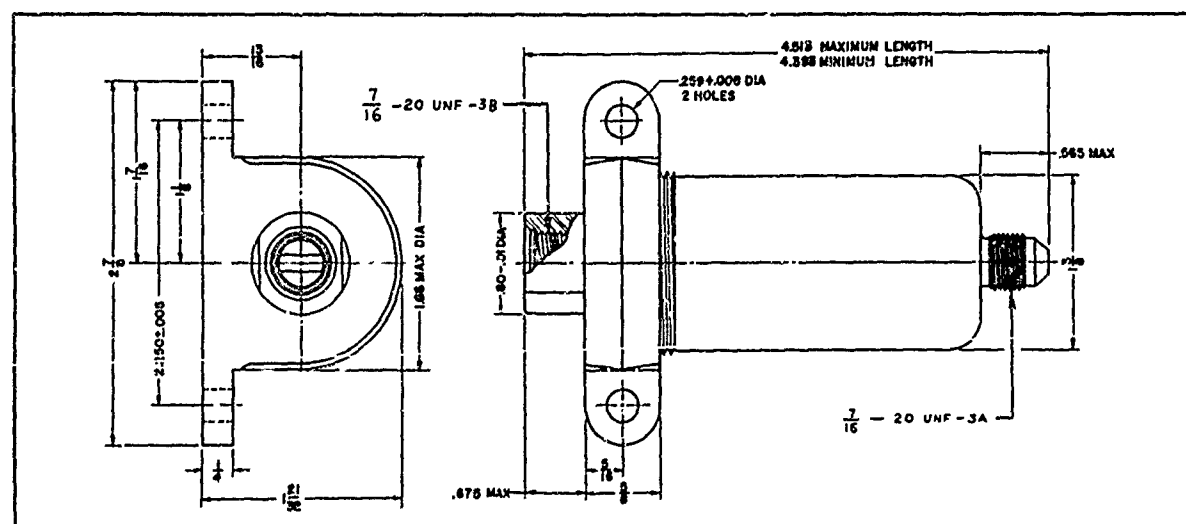
Propellant Actuated Devices

Initiator, Cartridge Actuated, M5A2



CROSS-SECTION DRAWING

Component	Component
A Plug, Shipping	F Cap, Shipping
B Pin, Shear	G Chamber, Initiator
C Cap	H Retainer, Cartridge
D Pin, Firing	I "O" Ring
E Housing, Firing Pin	J Cartridge, Initiator, M73 Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M6A1

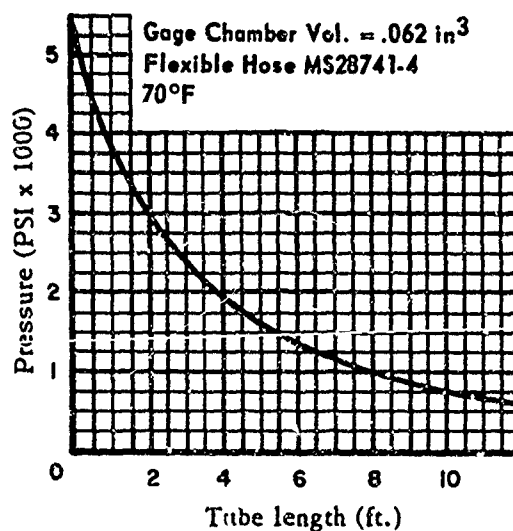
The M6A1 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M46 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for two seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

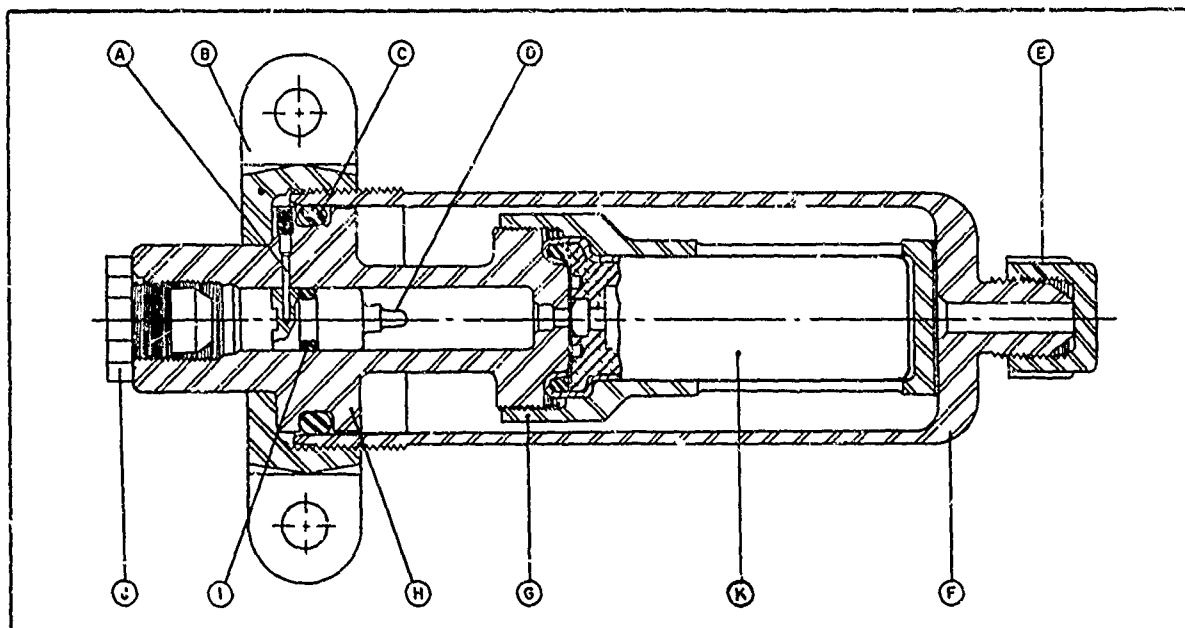
PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.

TYPICAL PERFORMANCE

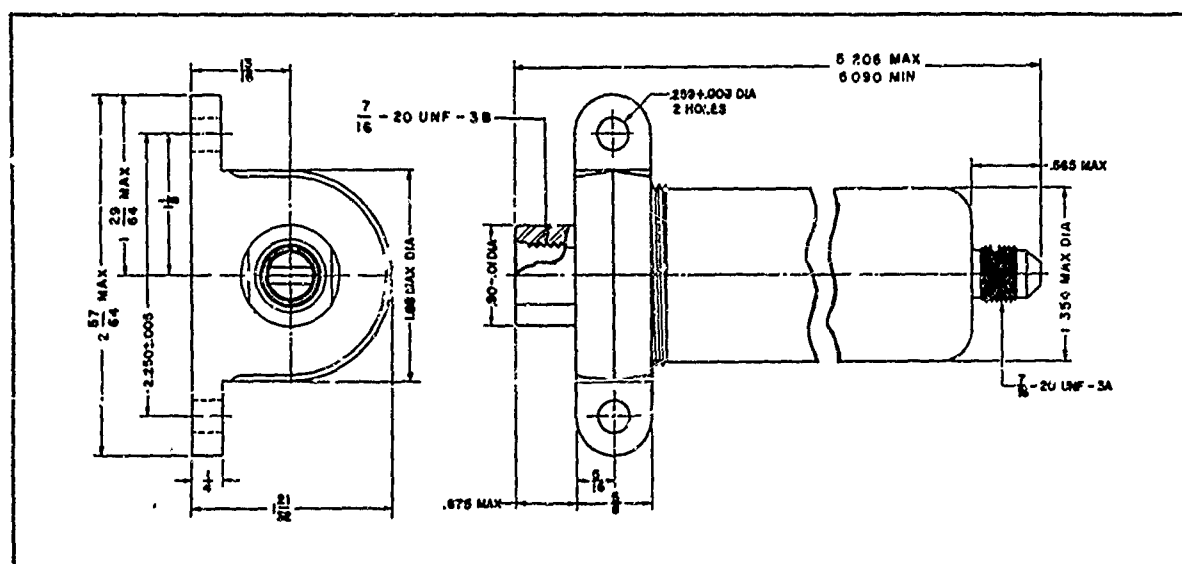


Initiator, Cartridge Actuated, Delay, M6A1



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	G Retainer, Cartridge
B Cap	H Housing, Firing Pin
C "O" Ring	I "O" Ring
D Pin, Firing	J Plug Shipping
E Cap, Shipping	K Cartridge, Initiator, Delay, M46 Assembly
F Chamber, Initiator	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M8

The M8 Initiator is a cylindrical constant volume device consisting of a mechanically operated firing mechanism, a chamber and end cap with a pressure outlet port incorporating a standard pressure fitting and an M68 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device. The M8 Initiator is capable of delivering to an .062 in.³ terminal chamber volume at the end of a 30 foot length of MS28741-4 hose, pressure within the limits of 1000 psi minimum and 3000 psi maximum.

PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	3.2 lbs.

Initiator, Cartridge Actuated, M8



<u>Component</u>	<u>Component</u>
A Guide, Firing Pin	J Cap, End
B Spring, Firing	K Cap, Shipping
C Ball	L Body
D Guide, Firing Pin	M Strap
E Pin, Firing	N Stand
F Screw, Set	O Wire Lock
G Cartridge, M68	P Pin, Safety
H "O" Ring	Q Cap, Initiator
I Filter	



Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M9

The M9 Initiator is a cylindrical constant volume device consisting of a gas pressure actuated firing mechanism, a chamber and end cap with a pressure outlet port incorporating a standard pressure fitting and an M69 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

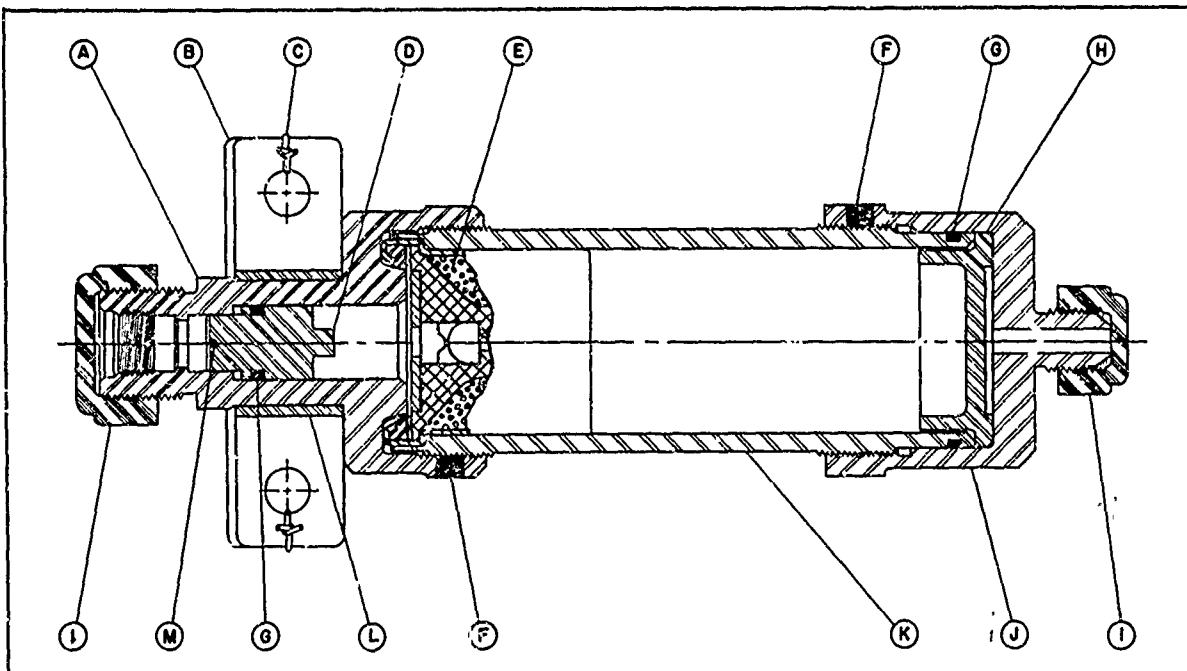
Upon cartridge function, the gas produced by burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device. The M9 Initiator is capable of delivering to an .062 in³ terminal chamber volume at the end of a 30 foot length of MS28741-4 hose, pressure within the limits of 1000 psi minimum and 3000 psi maximum.

PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	3.2 lbs.

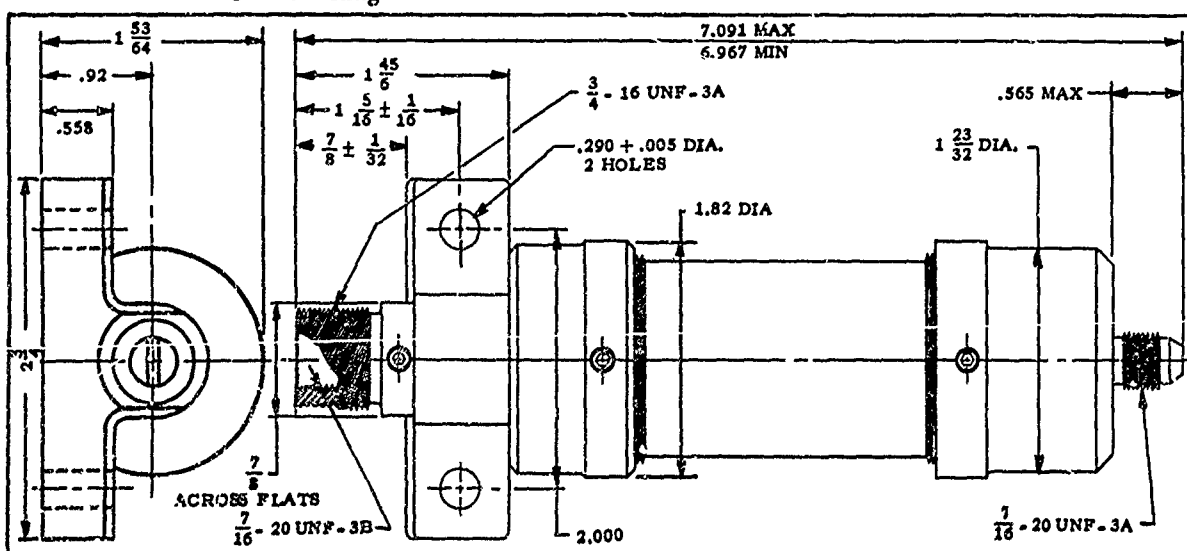
Propellant Actuated Devices

Initiator, Cartridge Actuated, M9



CROSS-SECTION DRAWING

Component	Component
A Cap, Initiator	H Filter
B Stand	I Cap, Shipping
C Wire, Lock	J Cap, End
D Pin, Firing	K Body
E Cartridge, Initiator, M69 Assembly	L Strap
F Screw, Set	M Pin, Shear And Screw, Set
G "O" Ring	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M10

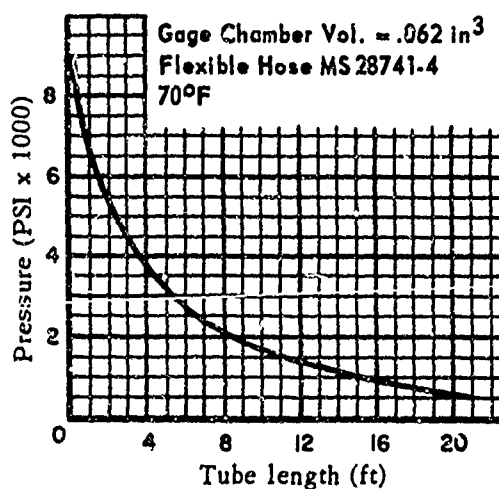
The M10 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M70 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for two seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

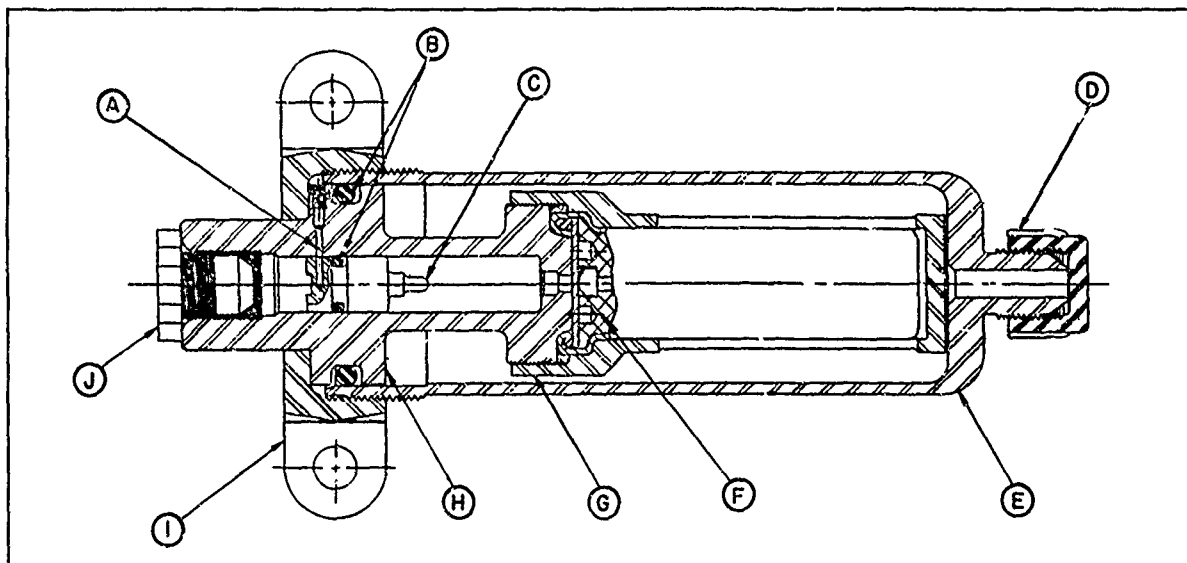
Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	2.0 seconds

TYPICAL PERFORMANCE



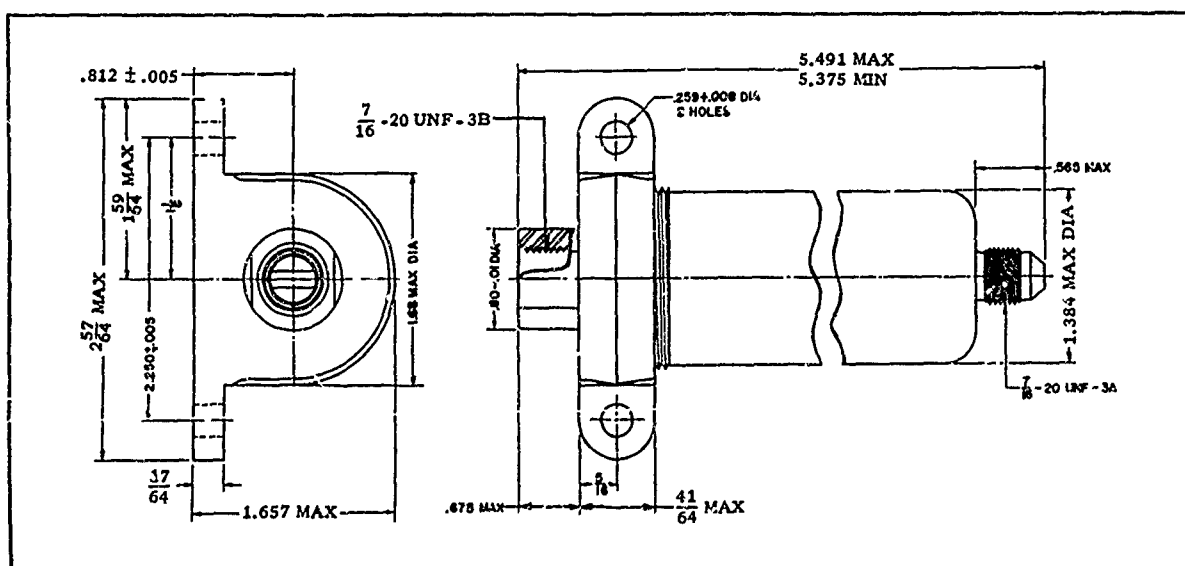
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M10



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	F Cartridge, Initiator, Delay, M70 Assembly
B "O" Ring	G Retainer, Cartridge
C Pin, Firing	H Housing, Firing Pin
D Cap, Shipping	I Cap
E Chamber, Initiator	J Plug, Shipping



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR CARTRIDGE ACTUATED, DELAY, M12A1

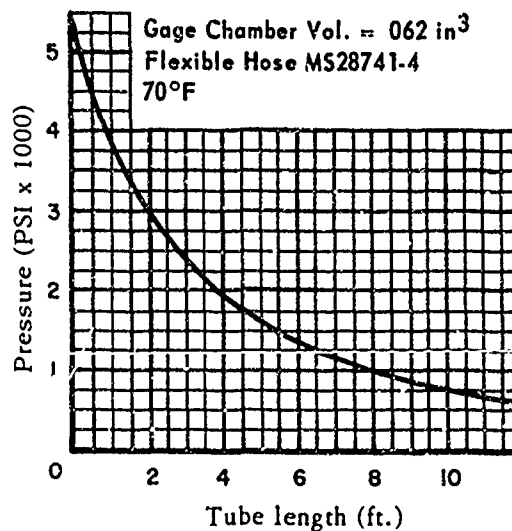
The M12A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M71 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

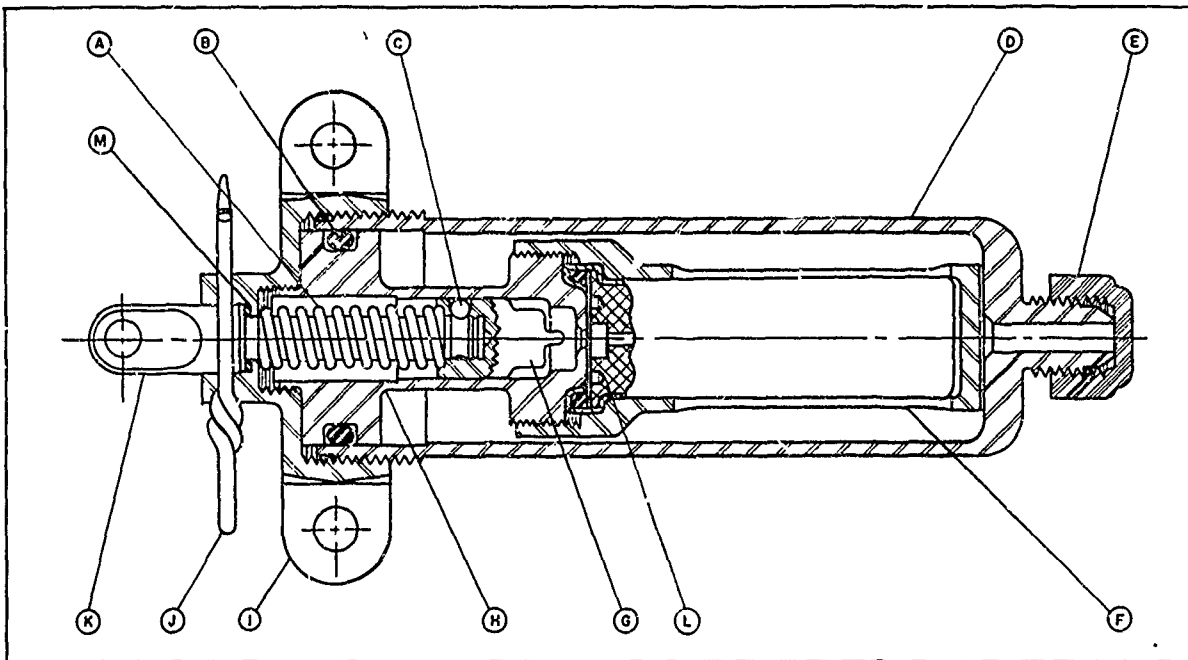
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	1.0 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE



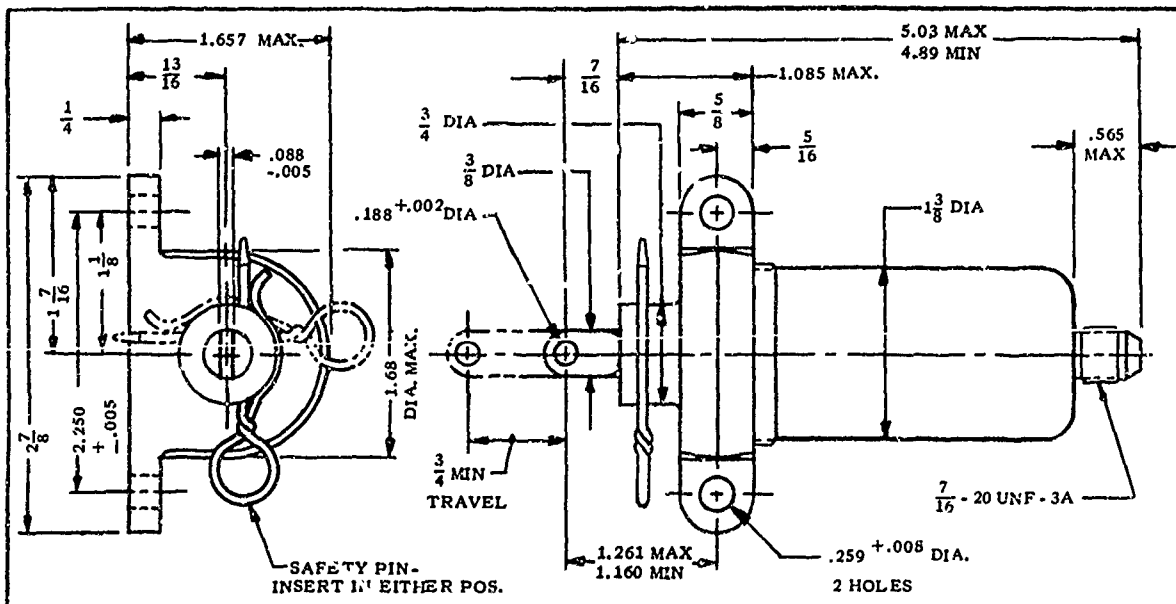
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M12A1



CROSS-SECTION DRAWING

Component	Component
A Spring, Initiator	H Housing, Firing Pin
B "O" Ring	I Cap
C Ball	J Pin, Safety
D Chamber, Initiator	K Pin, Initiator
E Cap, Shipping	L Cartridge, Initiator, Delay, M71 Assembly
F Retainer, Cartridge	M Seal
G Pin, Firing	



ENVELOPE DRAWING

Initiators

INITIATORS, CARTRIDGE ACTUATED, DELAY, M14

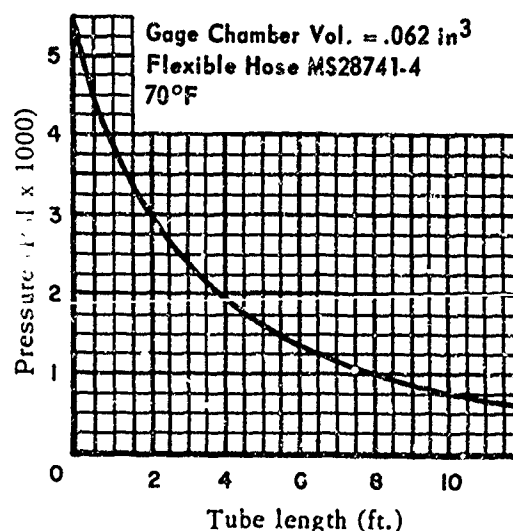
The M14 Delay Initiator, a miniature version of the M45A1 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure firing, a mechanically operated firing mechanism and an M84 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M25 Delay Element contained in the cartridge, burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

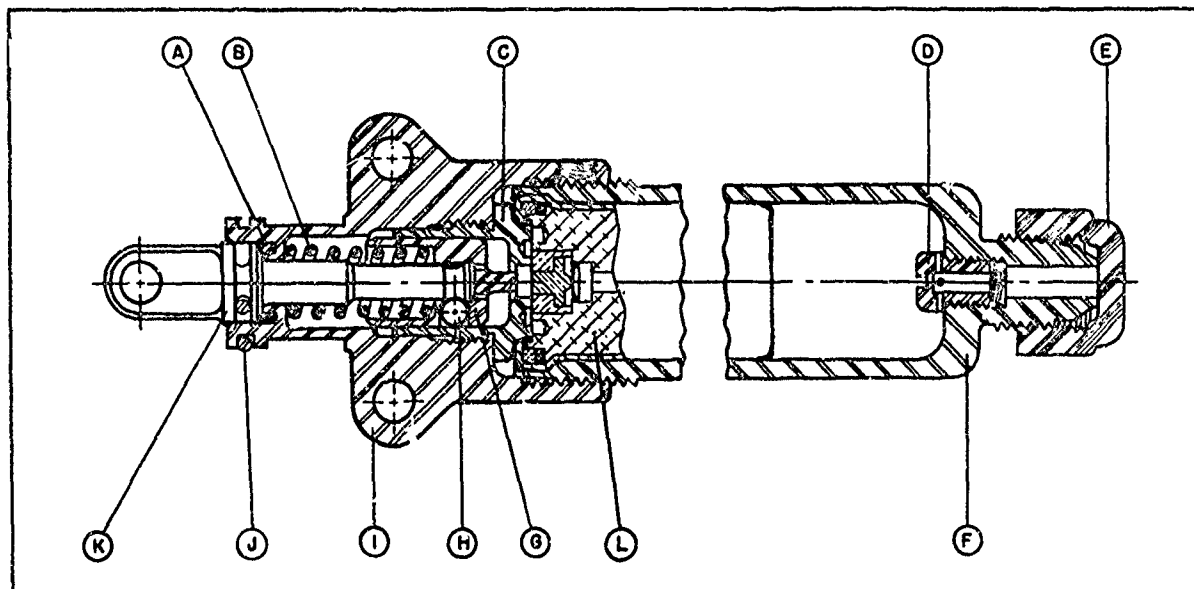
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



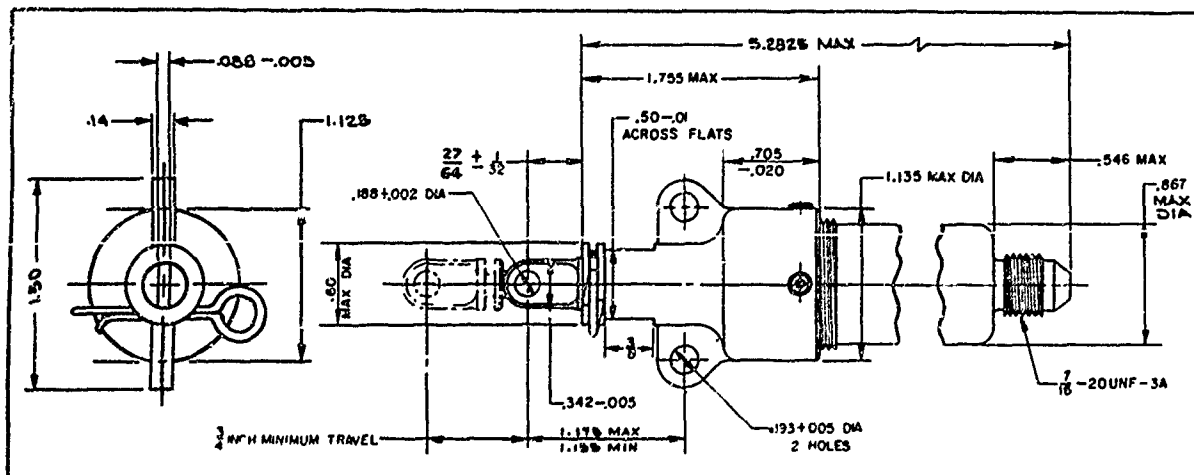
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M14



CROSS-SECTION DRAWING

Component	Component
A Seal	G Pin, Firing
B Spring, Initiator	H Balls (3)
C Housing, Firing Pin	I Cap, Initiator
D Filter	J Pin, Safety
E Cap, Shipping	K Pin, Initiator
F Chamber, Initiator	L Cartridge, Initiator, Delay, M84 Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M15

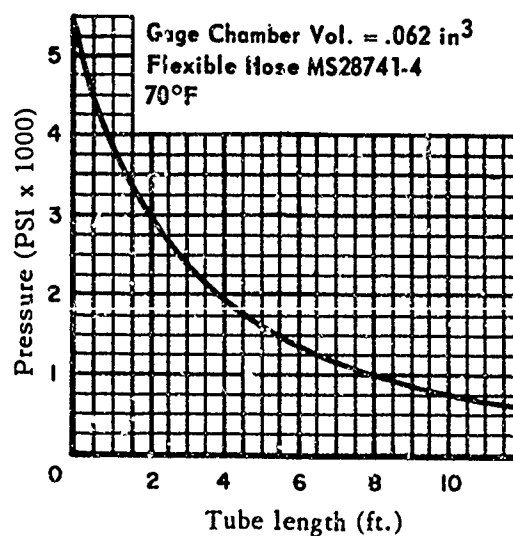
The M15 Delay Initiator, a miniature version of the M44 Delay Initiator, consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M84 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M25 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

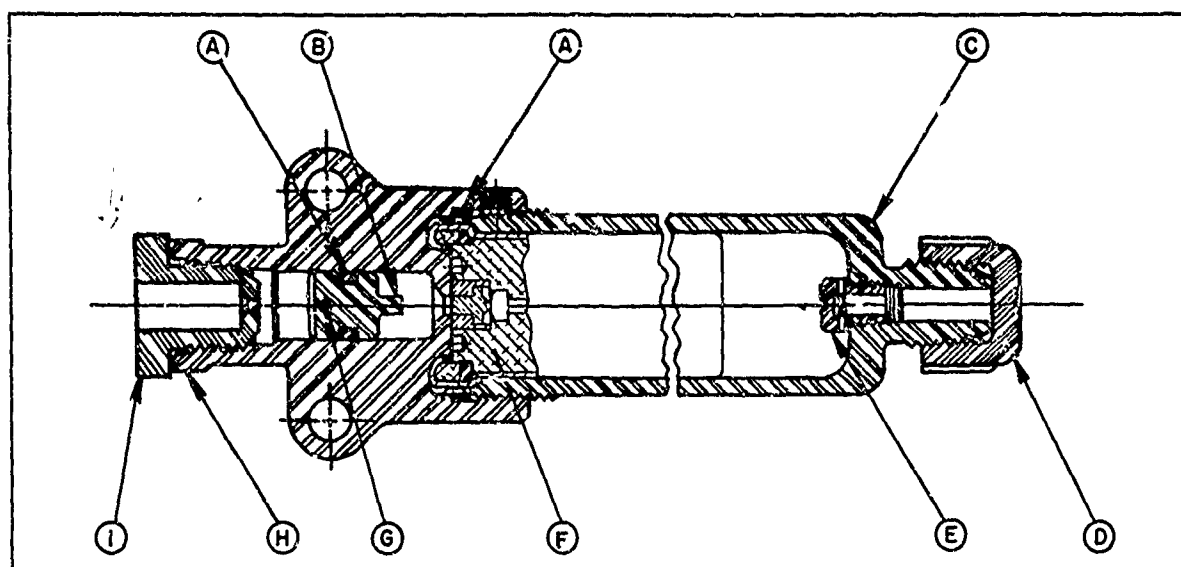
Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



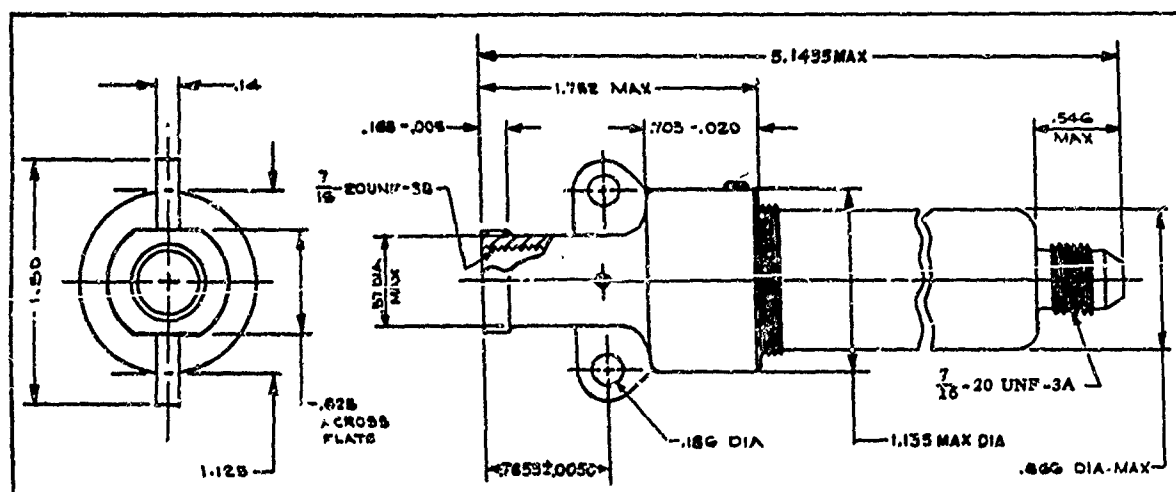
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M15



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	F Cartridge, Initiator, Delay, M84 Assembly
B Pin, Firing	G Pin, Shear
C Chamber, Initiator	H Cap, Initiator
D Cap, Shipping	I Plug, Shipping
E Filter	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M16

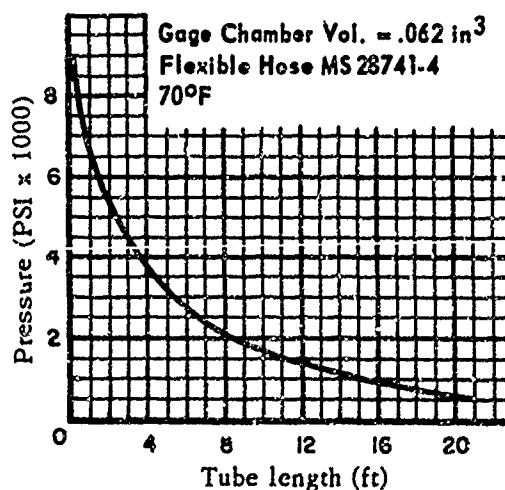
The M16 Delay Initiator, a miniature version of the M43 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M85 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M25 Delay Element contained in the cartridge, burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

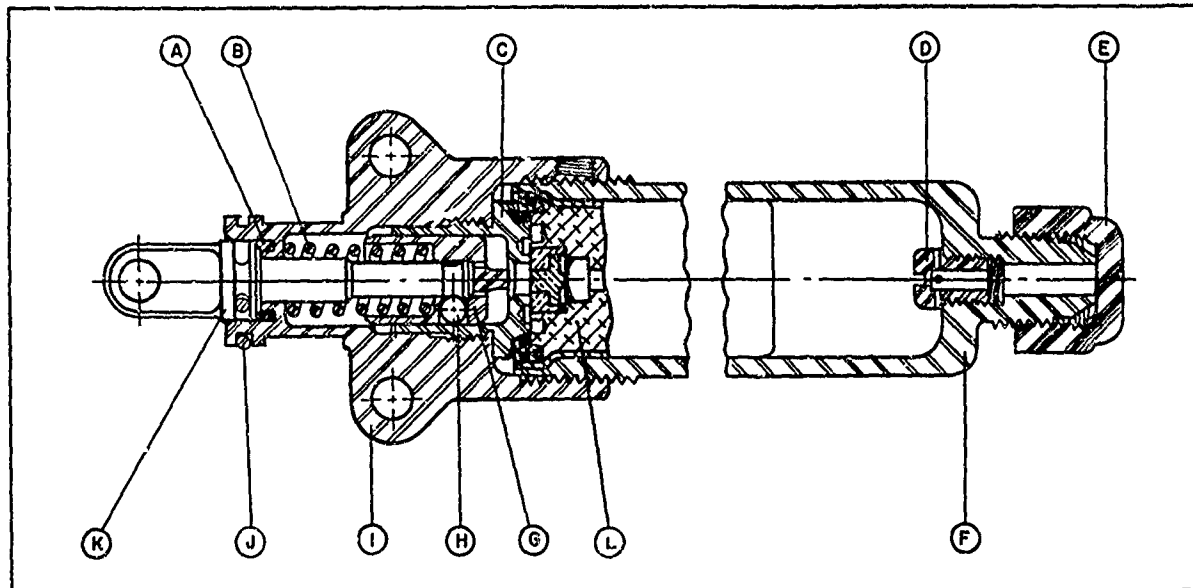
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M16



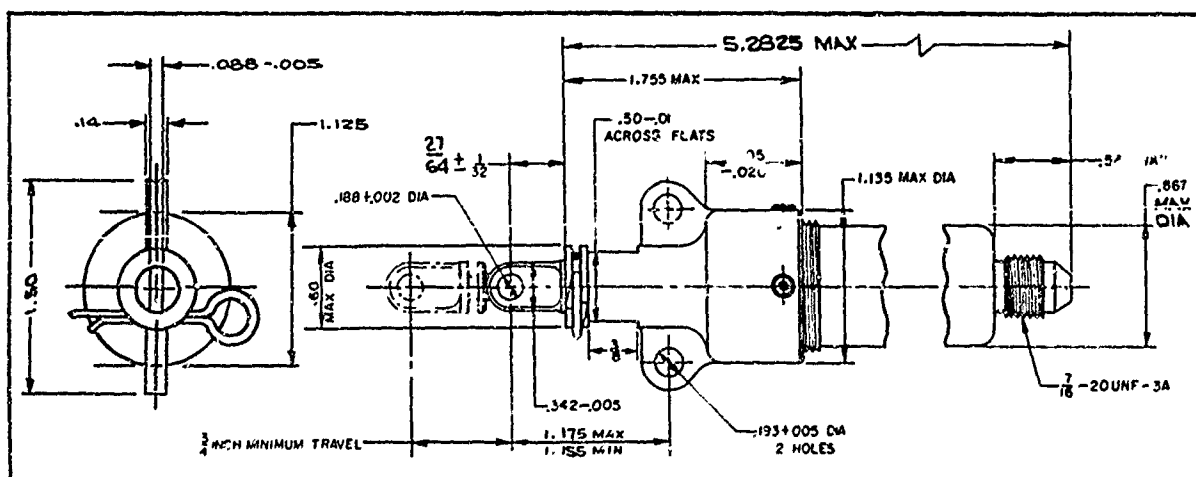
CROSS-SECTION DRAWING

Component

- A Seal
- B Spring, Initiator
- C Housing, Firing Pin
- D Filter
- E Cap, Shipping
- F Chamber, Initiator

Component

- G Pin, Firing
- H Balls (3)
- I Cap, Initiator
- J Pin, Safety
- K Pin, Initiator
- L Cartridge, Initiator, Delay, M85 Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM17

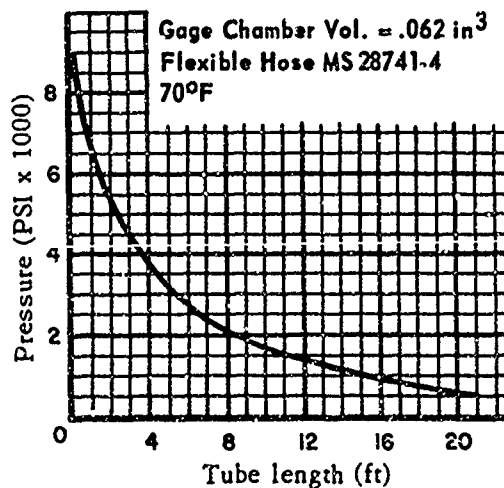
The XM17 Delay Initiator, a miniature version of the M43 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M85 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M25 Delay Element contained in the cartridge, burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

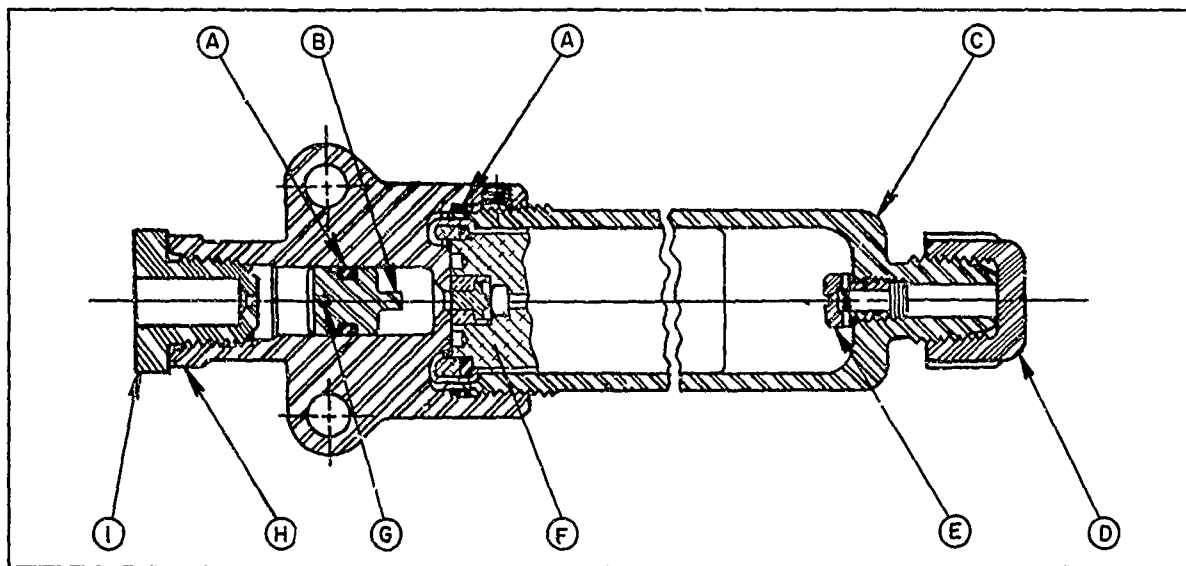
Actuation Method	Gas Pressure
Actuation Force	750 psi, min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



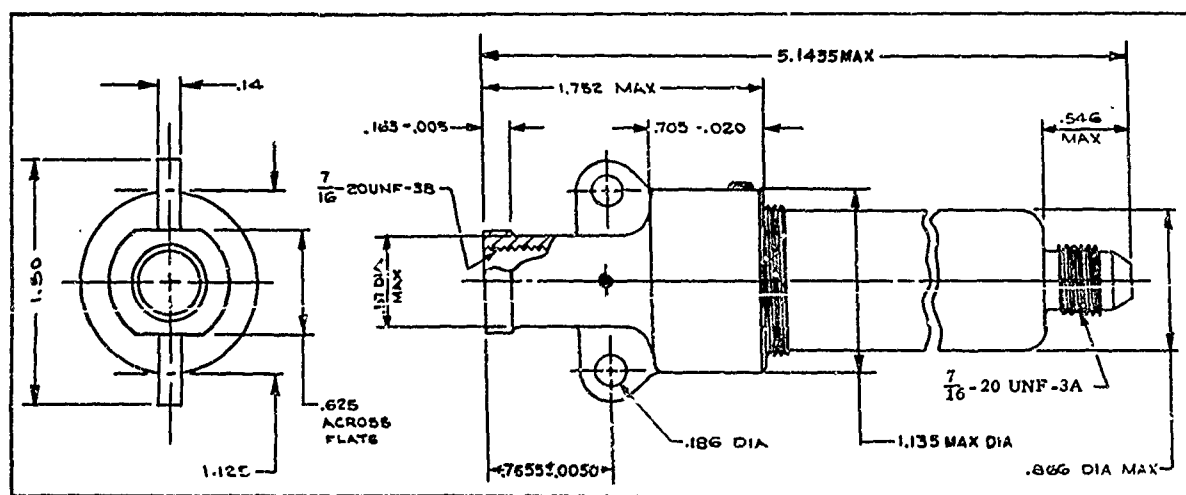
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM17



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	F Cartridge, Initiator, Delay, M85 Assembly
B Pin, Firing	G Pin, Shear
C Chamber, Initiator	H Cap, Initiator
D Cap, Shipping	I Plug, Shipping
E Filter	



ENVELOPE DRAWING

INITIATORS, CARTRIDGE ACTUATED, DELAY, XM18

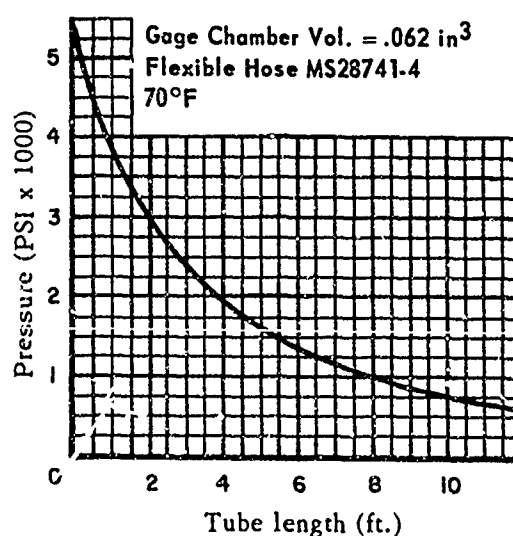
The XM18 Delay Initiator, a miniature, version of the M45A1 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM86 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM23 Delay Element contained in the cartridge, burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

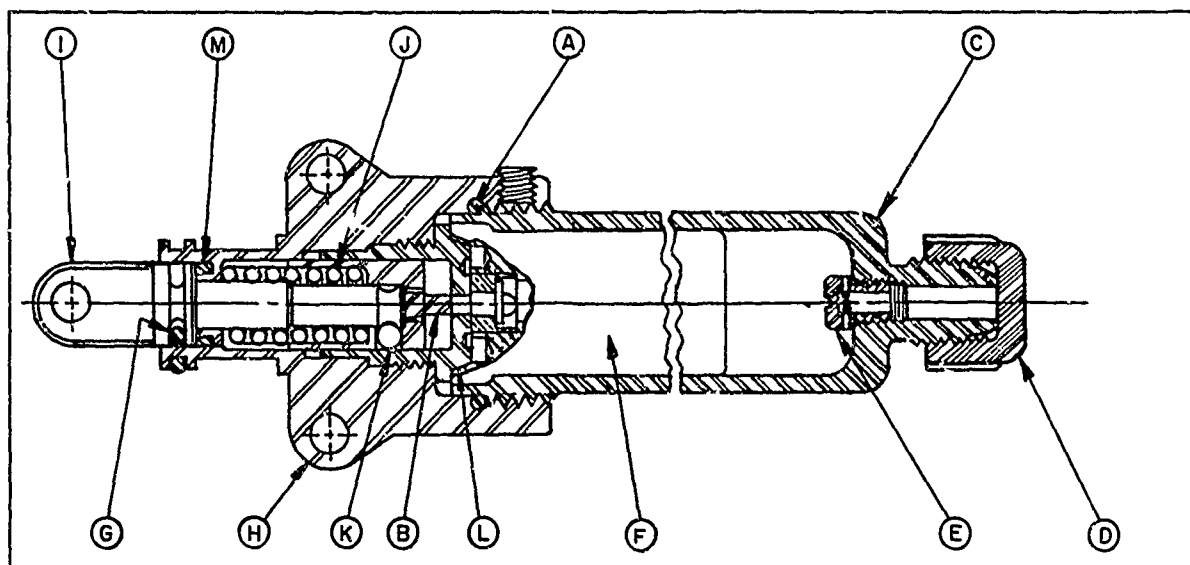
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	1 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE



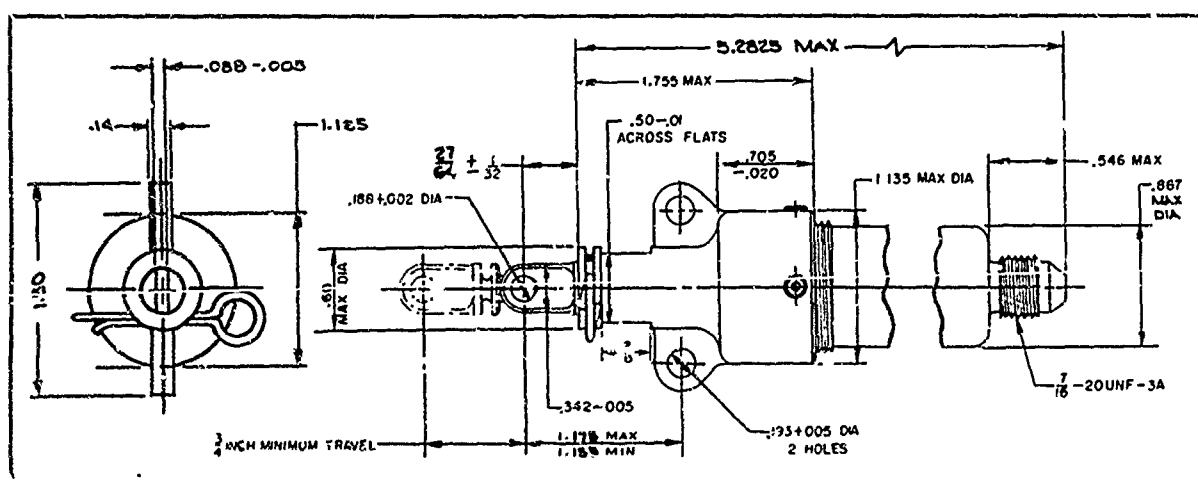
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM18



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Pin, Safety
B Pin, Firing	H Cap, Initiator
C Chamber, Initiator	I Pin, Initiator
D Cap, Shipping	J Spring, Initiator
E Filter	K Balls (3)
F Cartridge, Initiator, Delay XM86 Assembly	L Housing, Firing Pin
	M Seal



ENVELOPE DRAWING

Initiators

INITIATORS, CARTRIDGE ACTUATED, DELAY, XM19

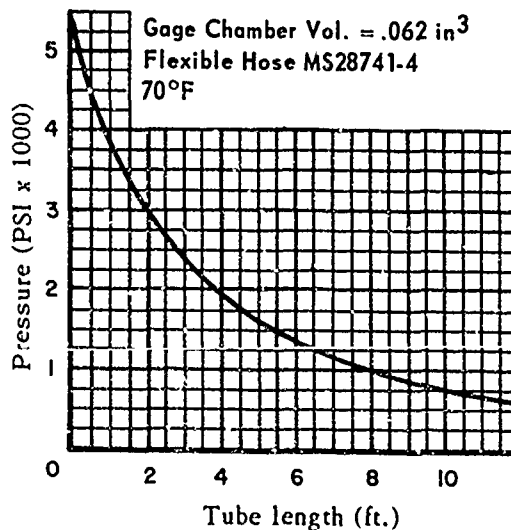
The XM19 Delay Initiator, a miniature version of the M45A1 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an XM86 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM23 Delay Element contained in the cartridge, burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

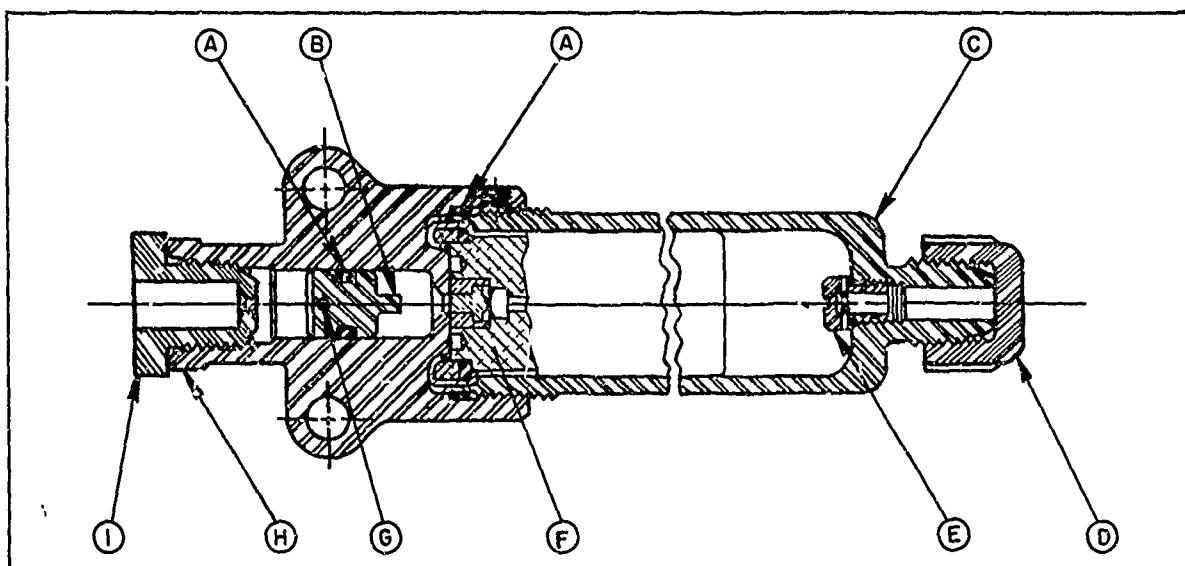
Actuation Method	Gas Pressure
Actuation Force	750 psi, min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	1 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE



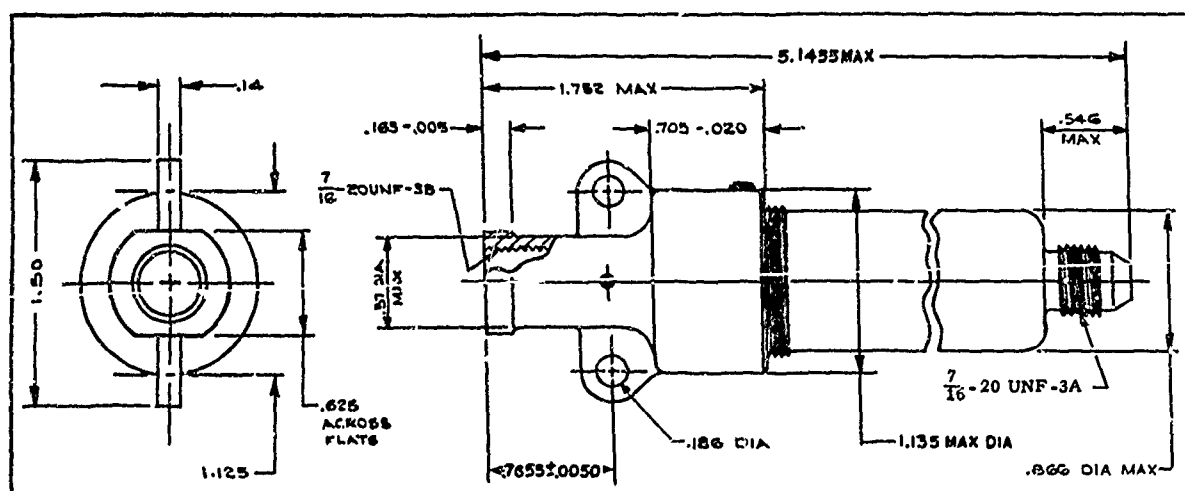
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM19



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	F Cartridge, Initiator, Delay, XM86 Assembly
B Pin, Firing	G Pin, Shear
C Chamber, Initiator	H Cap, Initiator
D Cap, Shipping	I Plug, Shipping
E Filter	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM20

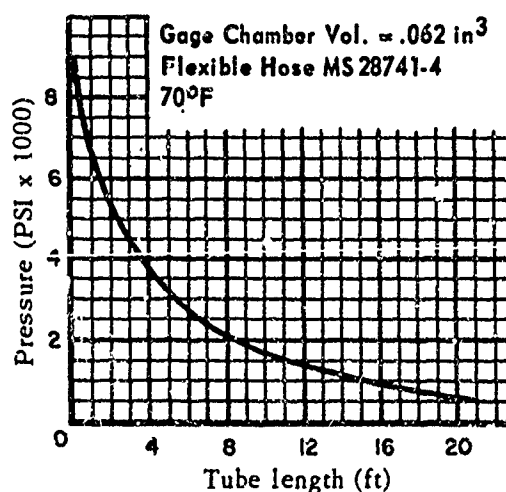
The XM20 Delay Initiator, a miniature version of the M43A1 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM87 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM23 Delay Element contained in the cartridge, burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

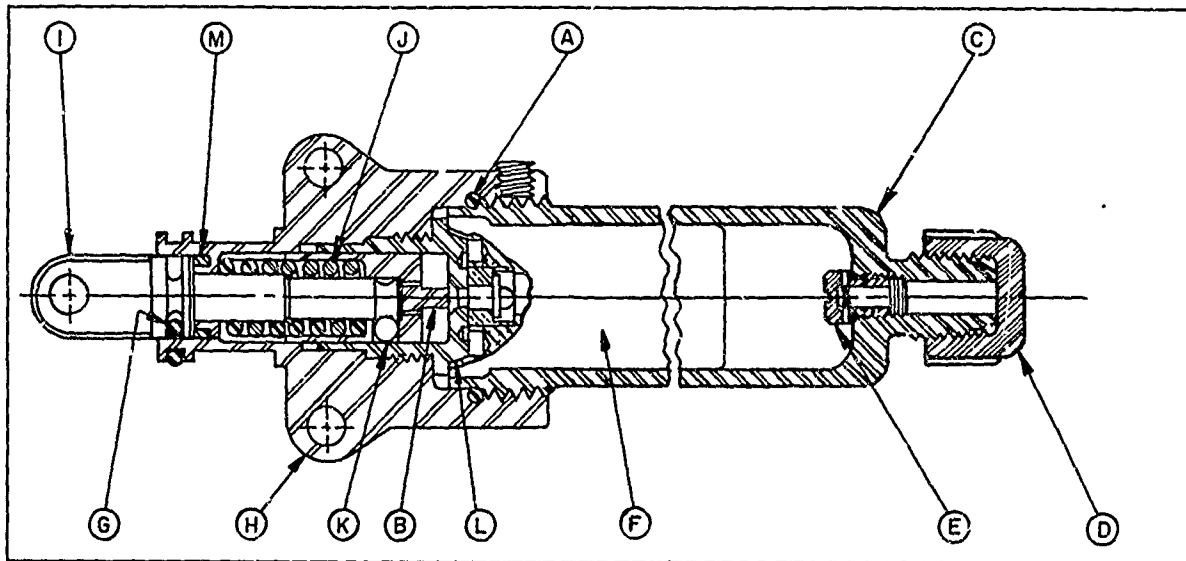
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	1 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE



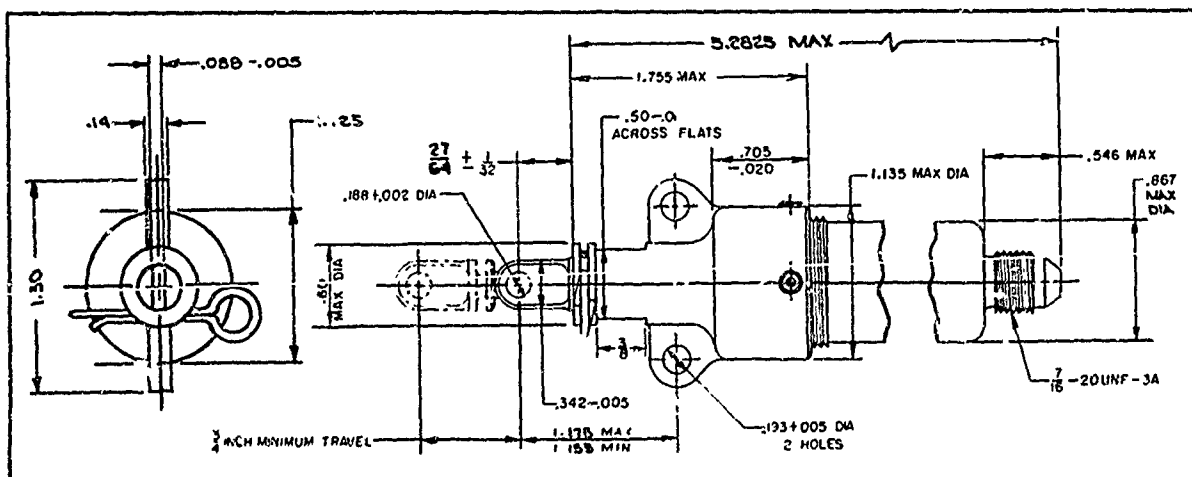
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM20



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Pin, Safety
B Pin, Firing	H Cap, Initiator
C Chamber, Initiator	I Pin, Initiator
D Cap, Shipping	J Spring, Initiator
E Filter	K Balls (3)
F Cartridge, Initiator, Delay, XM87 Assembly	L Housing, Firing Pin
	M Seal



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM21

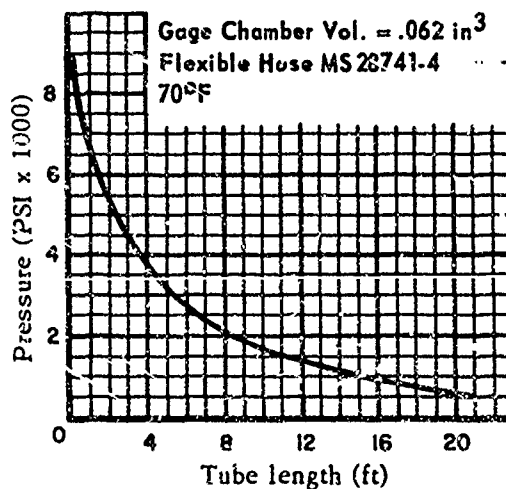
The XM21 Delay Initiator, a miniature version of the M43A1 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an XM87 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM23 Delay Element contained in the cartridge, burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

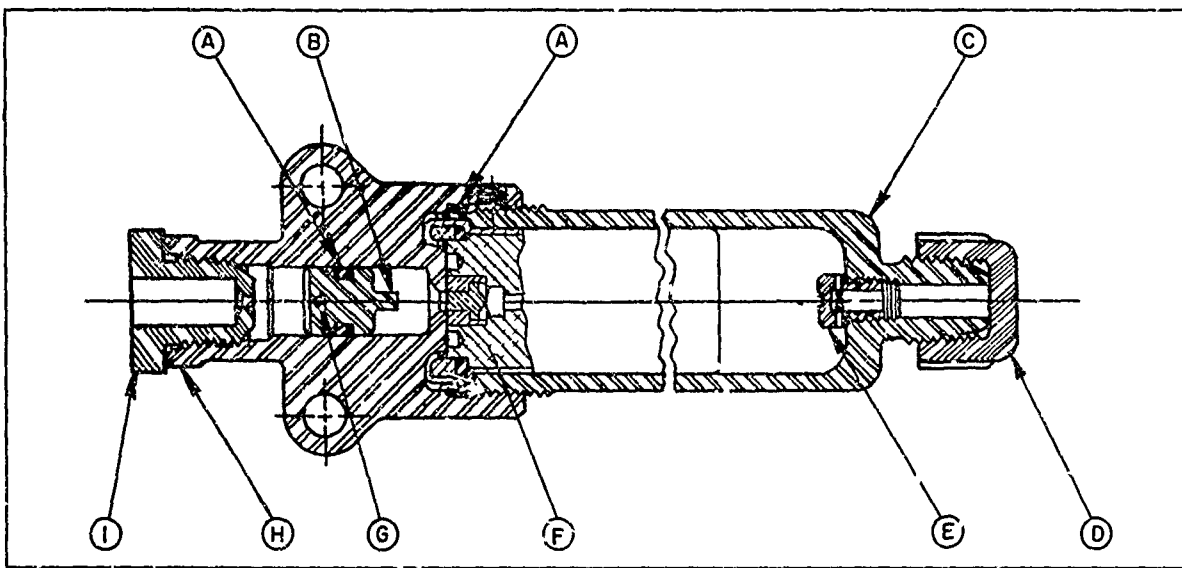
Actuation Method	Gas Pressure
Actuation Force	750 psi, min.
Temperature Limits	- 65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	1 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE



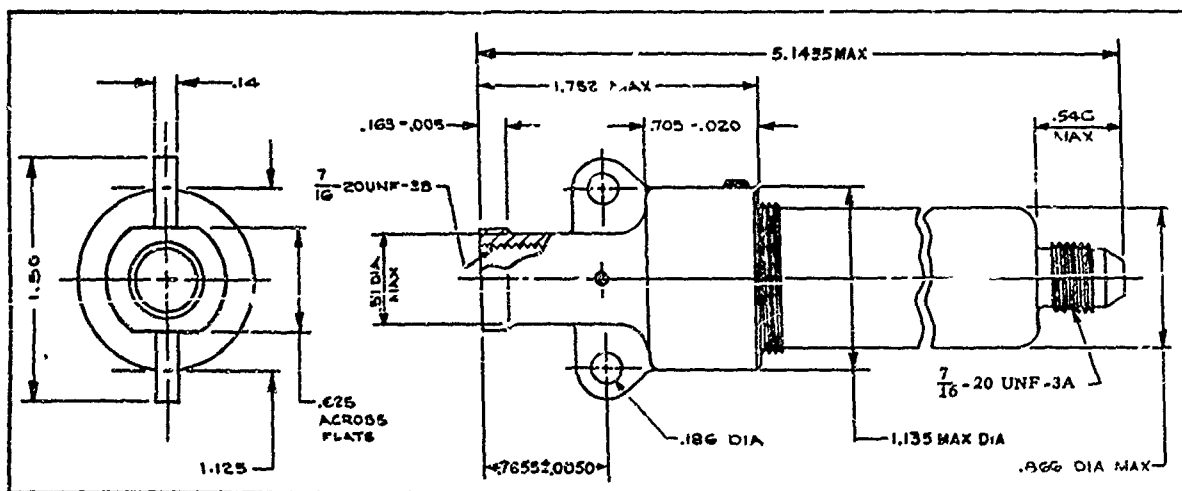
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM21



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	F Cartridge, Initiator, Delay, XM87 Assembly
B Pin, Firing	G Pin, Shear
C Chamber, Initiator	H Cap, Initiator
D Cap, Shipping	I Plug, Shipping
E Filter	



ENVELOPE DRAWING

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM22

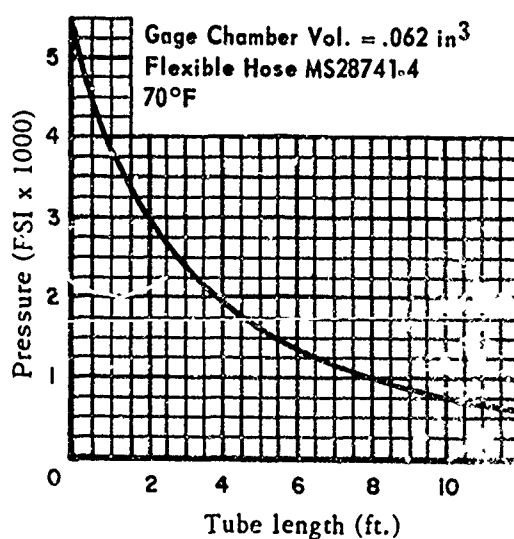
The XM22 Delay Initiator, a miniature version of the M44 Delay Initiator, consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM88 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

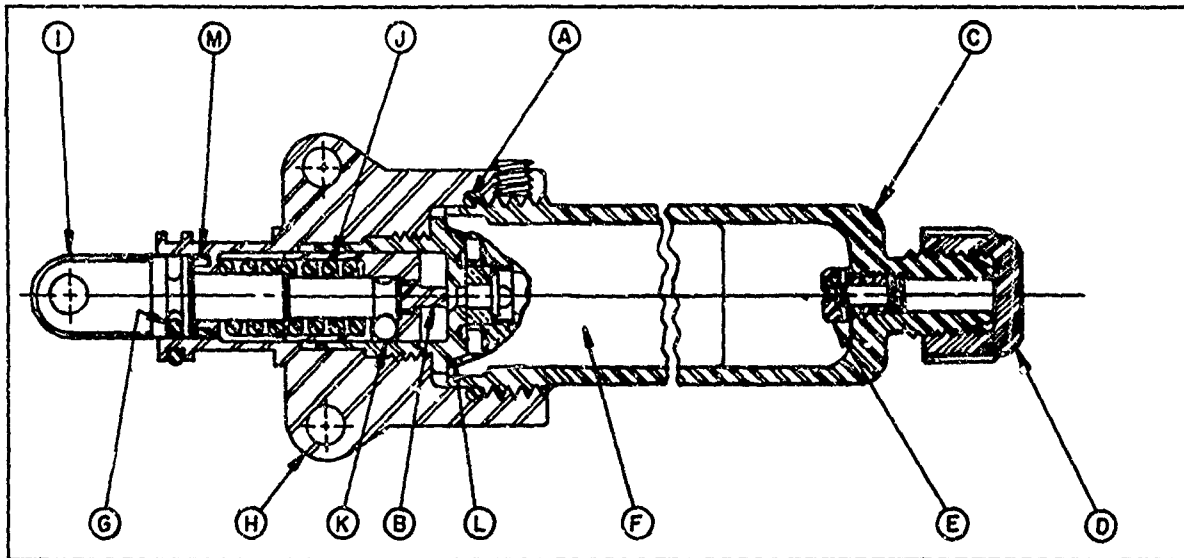
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	2 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



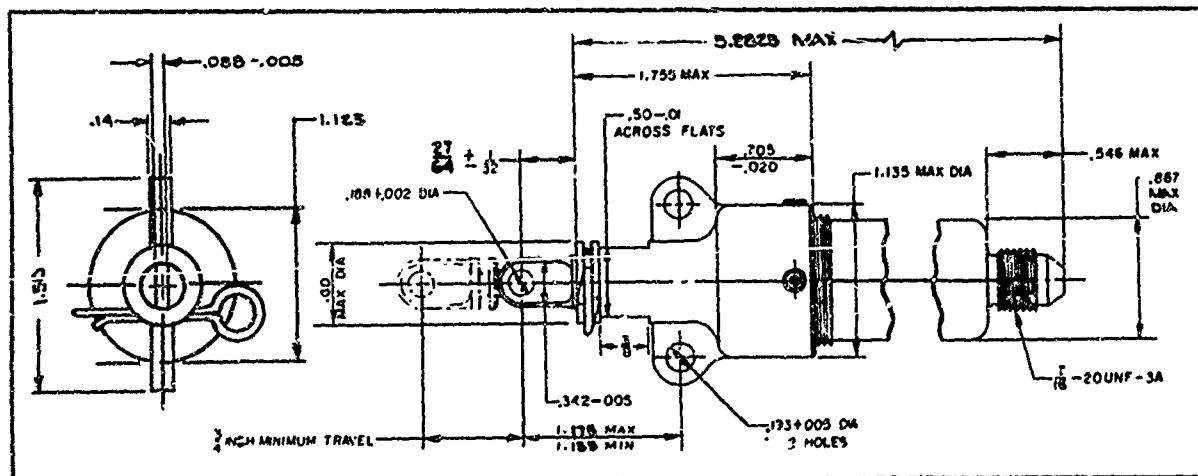
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay XM22



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Pin, Safety
B Pin, Firing	H Cap, Initiator
C Chamber, Initiator	I Pin, Initiator
D Cap, Shipping	J Spring, Initiator
E Filter	K Balls (3)
F Cartridge, Initiator, Delay, XM88 Assembly	L Housing, Firing Pin
	M Seal



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM23

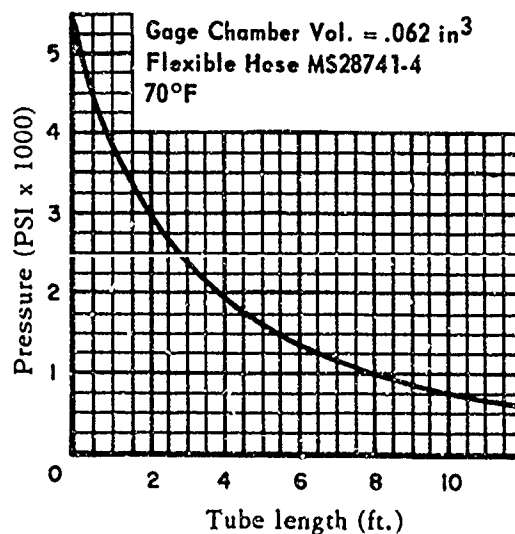
The XM23 Delay Initiator, a miniature version of the M44 Delay Initiator, consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an XM88 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

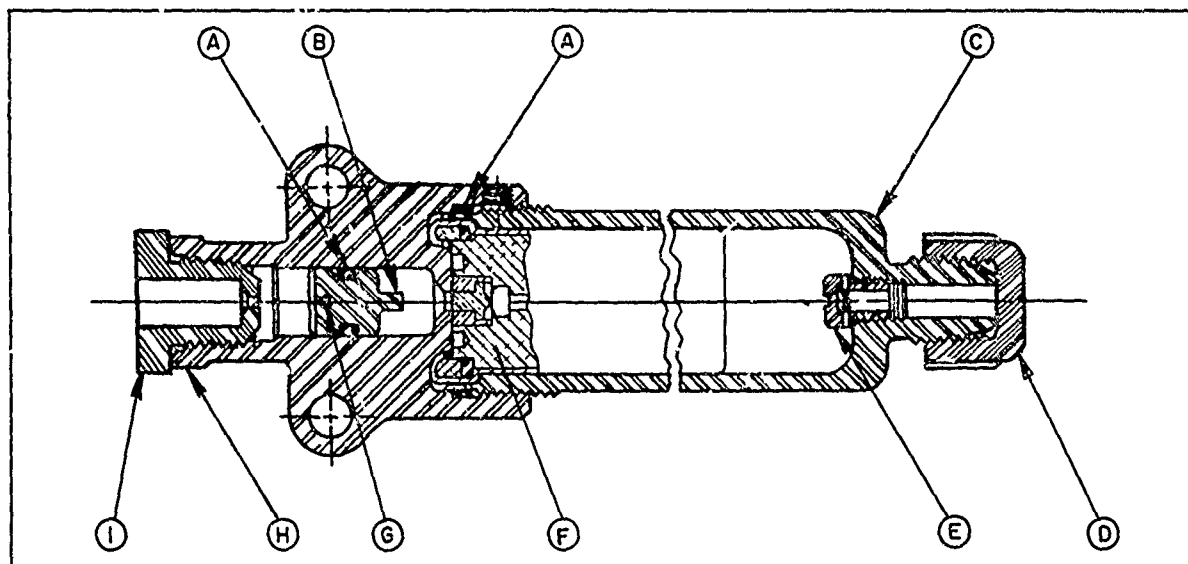
Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	2 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



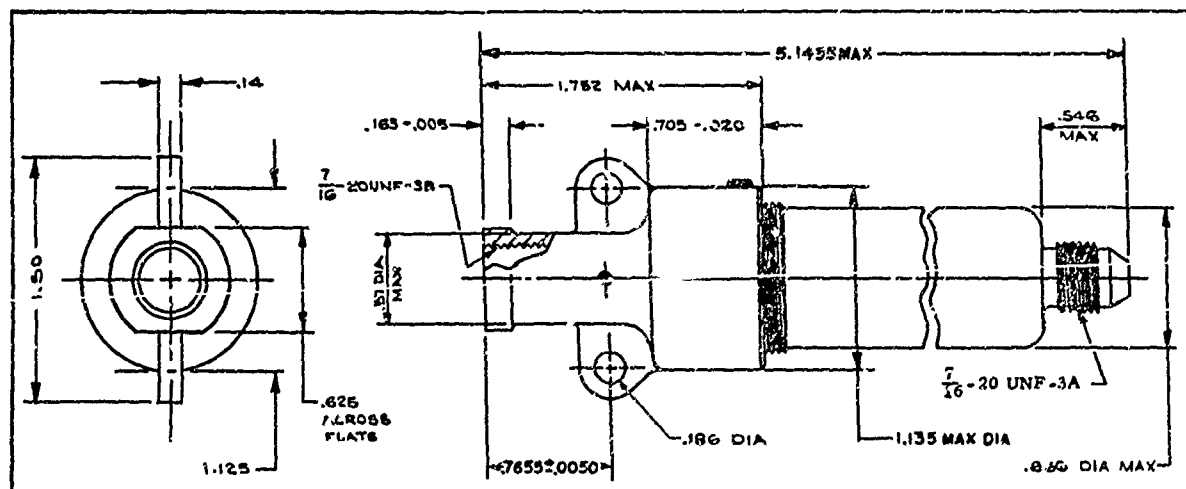
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM23



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	F Cartridge, Initiator, Delay, XM88 Assembly
B Pin, Firing	G Pin, Shear
C Chamber, Initiator	H Cap, Initiator
D Cap, Shipping	I Plug, Shipping
E Filter	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM24

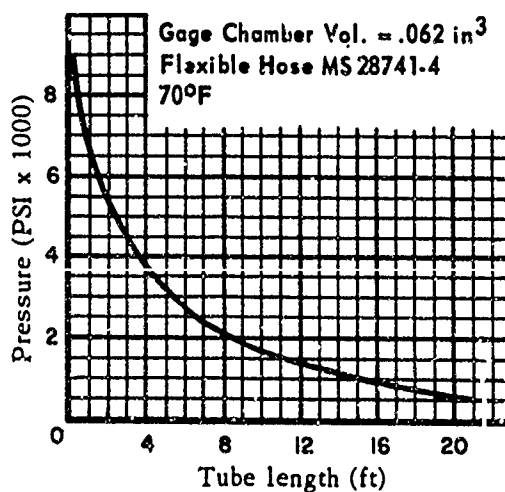
The XM24 Delay Initiator, a miniature version of the M43A1 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M89 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge, burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

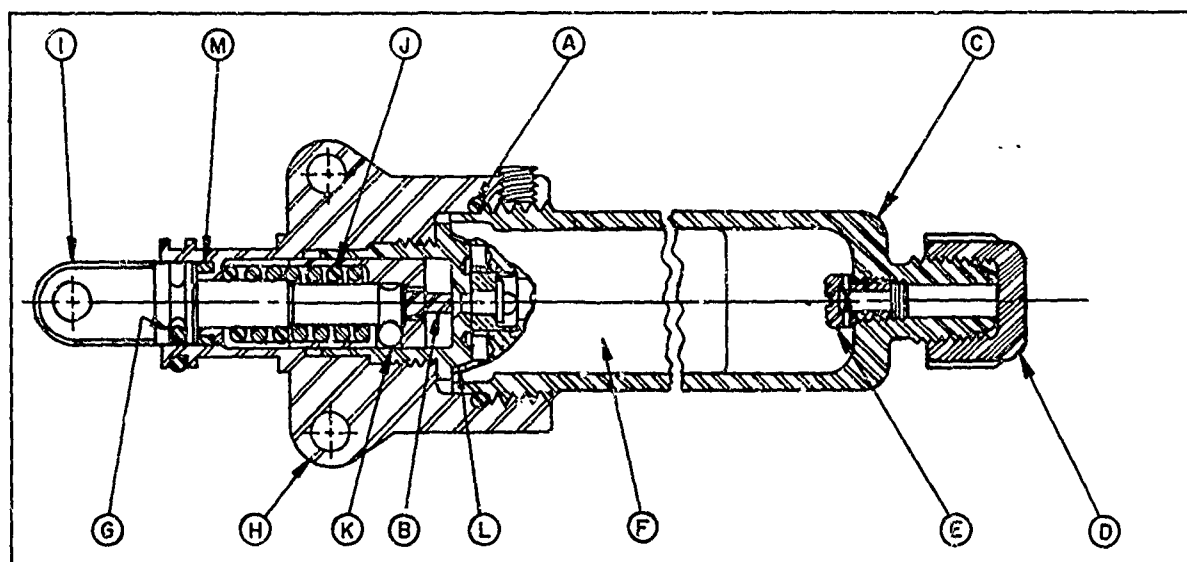
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	2 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



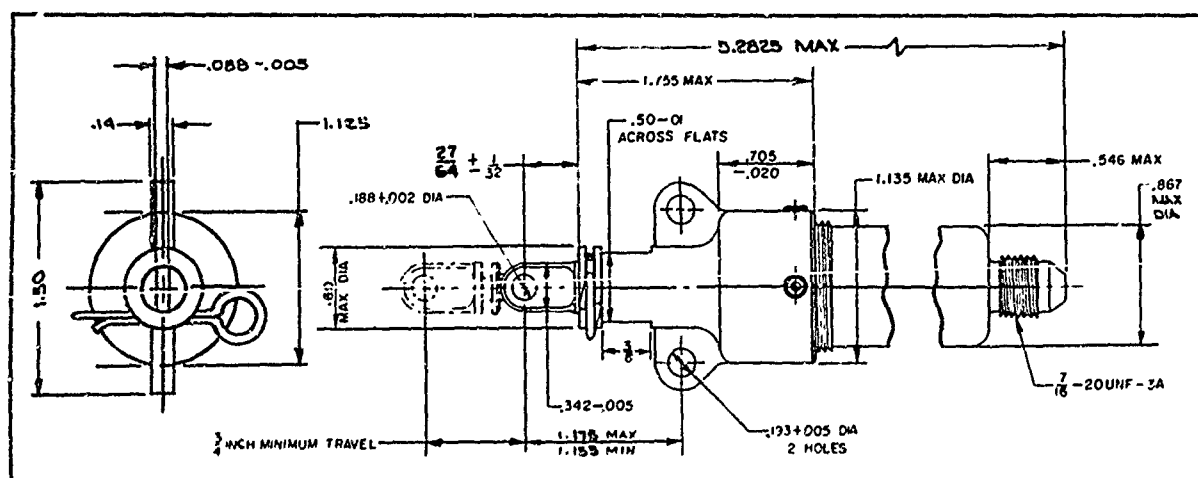
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM24



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Pin, Safety
B Pin, Firing	H Cap, Initiator
C Chamber, Initiator	I Pin, Initiator
D Cap, Shipping	J Spring, Initiator
E Filter	K Balls (3)
F Cartridge, Initiator, Delay, M89 Assembly	L Housing, Firing Pin
	M Seal



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM25

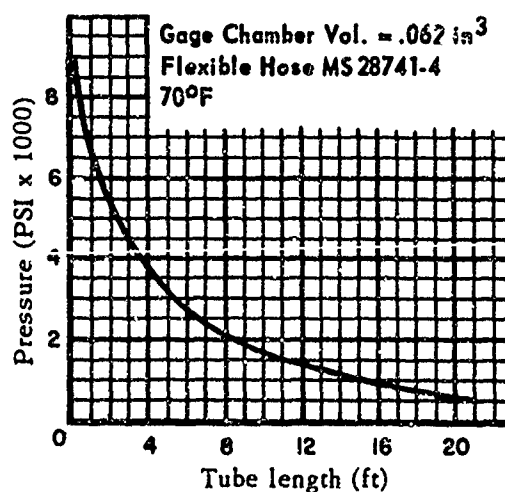
The XM25 Delay Initiator, a miniature version of the M43A1 Delay Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M89 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge, burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

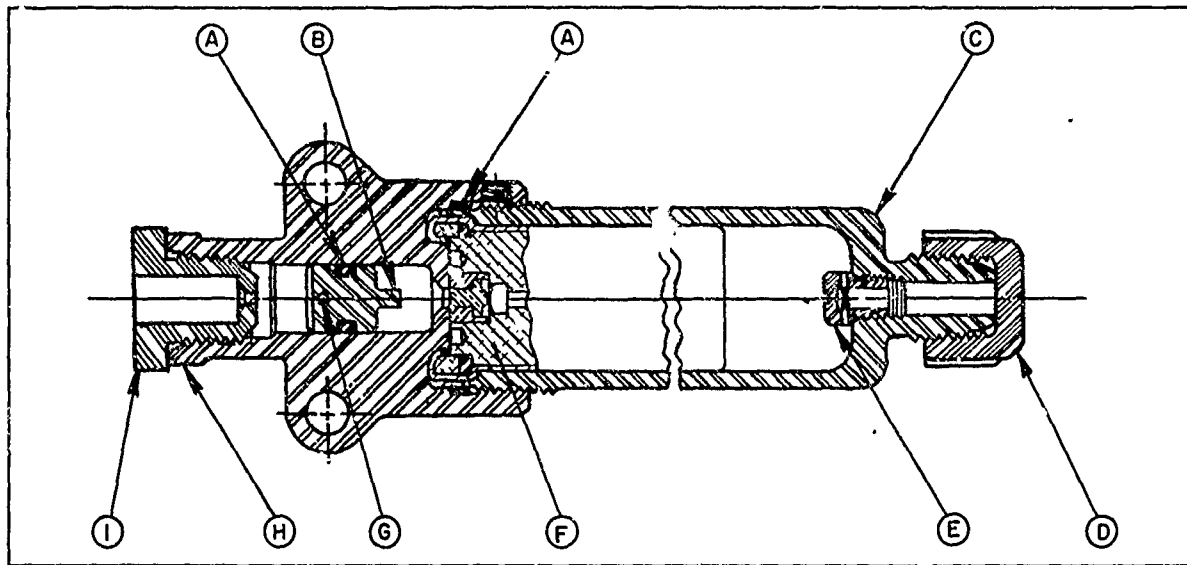
Actuation Method	Gas Pressure
Actuation Force	750 psi, min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	2 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



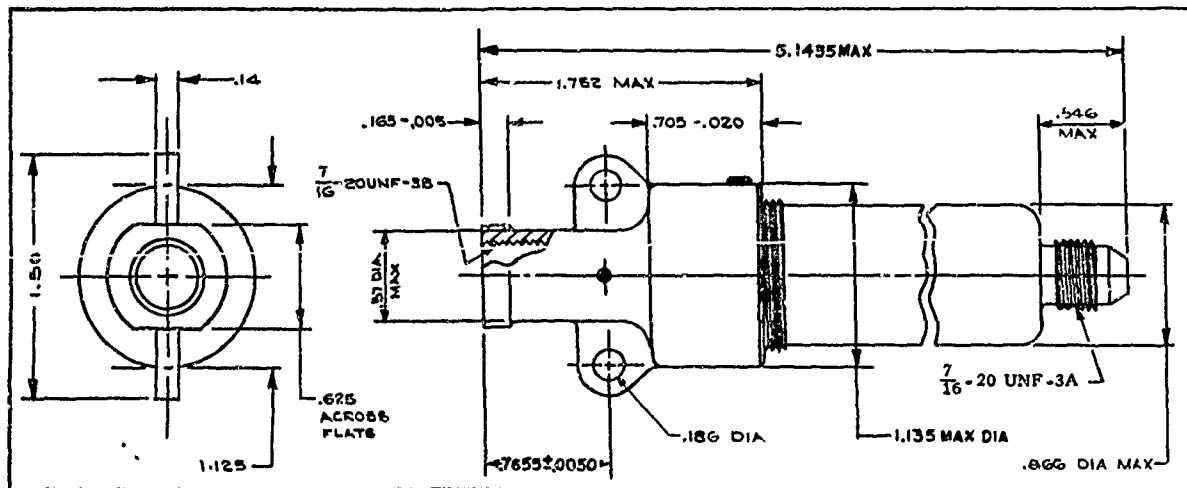
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM25



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	F Cartridge, Initiator, Delay, M89, Assembly
B Pin, Firing	G Pin, Shear
C Chamber, Initiator	H Cap, Initiator
D Cap, Shipping	I Plug, Shipping
E Filter	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M26

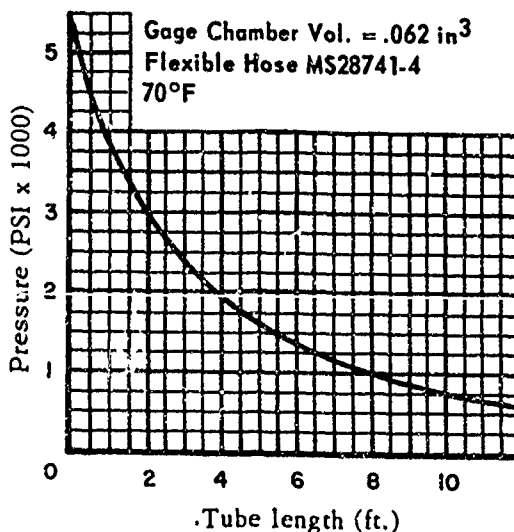
The M26 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M90 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M14 Delay Element contained in the cartridge burns for 0.3 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

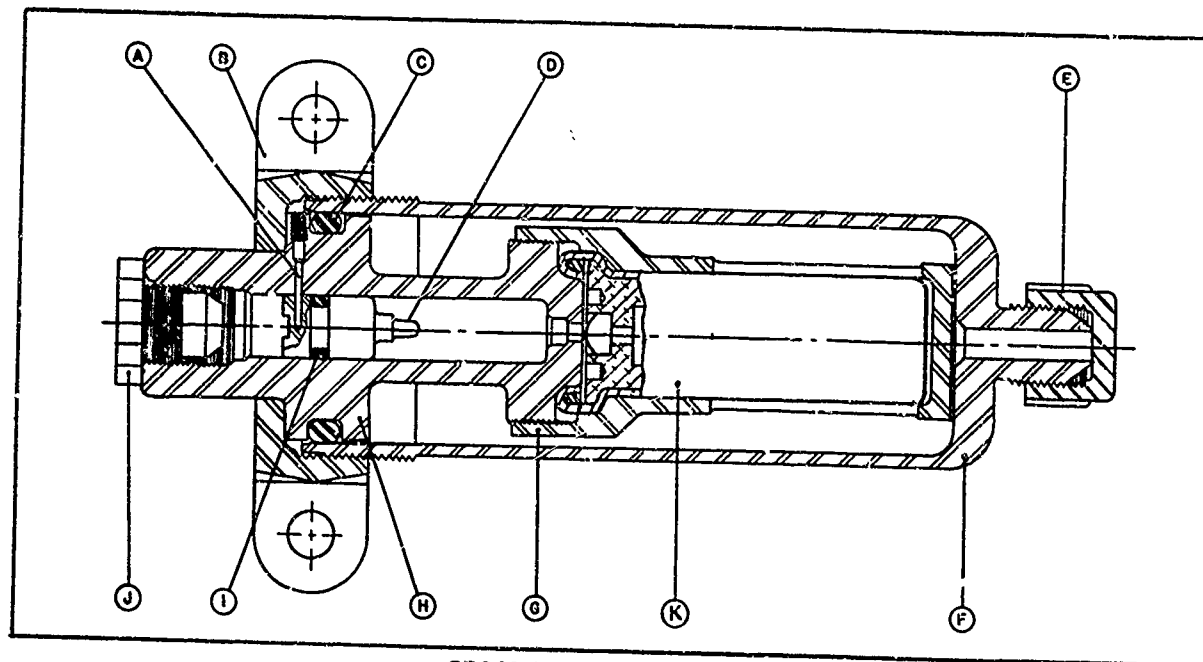
Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	0.3 second

TYPICAL PERFORMANCE



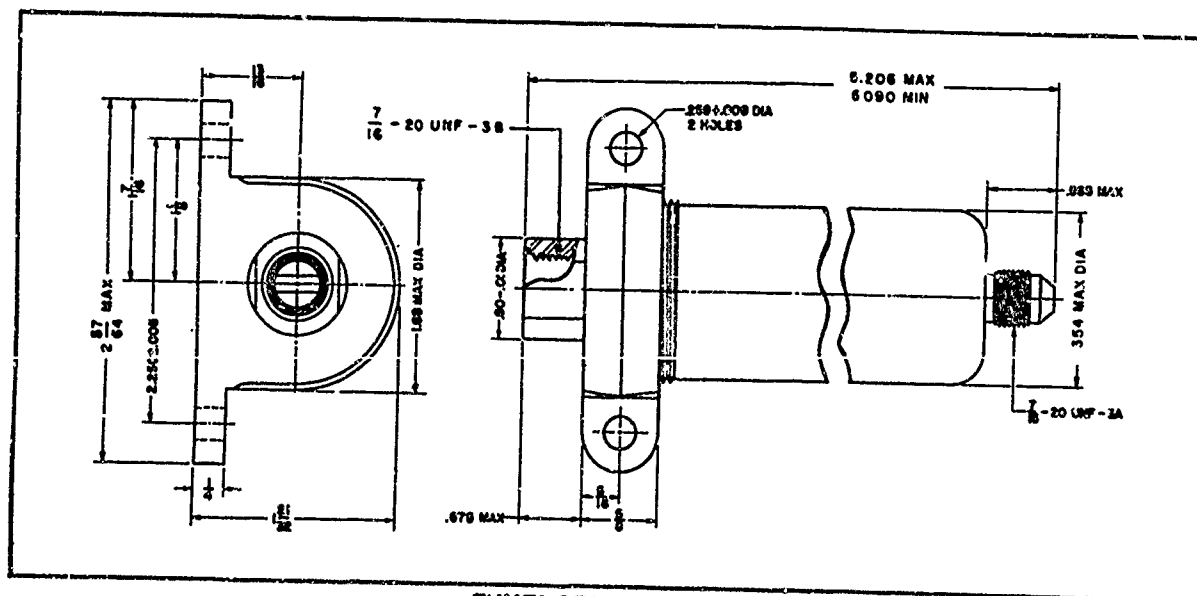
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M26



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	G Retainer, Cartridge
B Cap	H Housing, Firing Pin
C "O" Ring	I "O" Ring
D Pin, Firing	J Plug, Shipping
E Cap, Shipping	K Cartridge, Initiator, Delay, M90 Assembly
F Chamber, Initiator	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M27

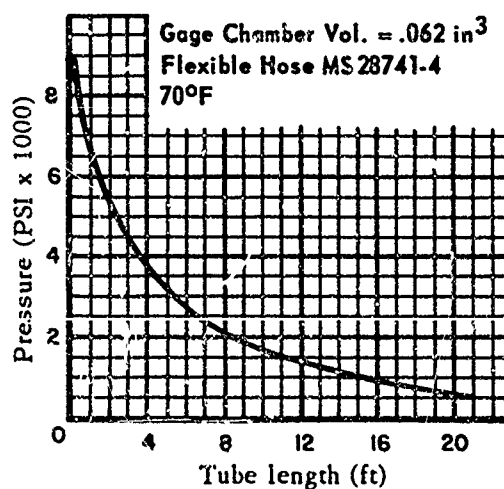
The M27 Initiator, a miniature version of the M3A1 Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M91 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65° to +160°F
Assembled Weight	0.33 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



Initiator, Cartridge Actuated, M2:



Technical drawing of a mechanical assembly, likely a valve or actuator, showing multiple views and dimensions.

Top View (Left): Shows a circular component with a central hole and a smaller hole offset to the right. Dimensions include a total width of 1.50, a central hole diameter of $\phi .088 \pm .005$, and a distance of .14 from the center to the offset hole.

Side View (Middle): Shows the profile of the assembly. Key dimensions include a total length of 4.1875 MAX, a distance of 1.75 MAX from the left face to the start of the main body, and a distance of 1.125 from the top of the main body to the centerline. A note indicates ".80 ± .01 ACROSS FLATS" for the main body section.

End View (Right): Shows the circular end of the assembly. Dimensions include a total diameter of $\phi .188 \pm .002$ DIA, a central hole diameter of $\phi .060$ MAX DIA, and a distance of .105 ± .020 from the centerline to the edge of the main body. A note indicates ".135 MAX DIA" for the main body section.

Bottom View (Bottom): Shows the base of the assembly. Key dimensions include a total width of 1.50, a central hole diameter of $\phi .088 \pm .005$, and a distance of .14 from the center to the offset hole. A note indicates ".188 ± .002 DIA" for the main body section. A dimension of 1.125 is shown from the top of the main body to the centerline. A note indicates ".80 ± .01 ACROSS FLATS" for the main body section. A dimension of 1.175 MAX is shown from the left face to the start of the main body. A dimension of 1.155 MAX is shown from the left face to the end of the main body. A dimension of .342 ± .005 is shown from the centerline to the edge of the main body. A note indicates ".188 DIA 2 HOLES" for the main body section. A dimension of .348 MAX is shown from the centerline to the edge of the main body. A note indicates ".135 MAX DIA" for the main body section. A dimension of .78 is shown from the centerline to the edge of the main body. A note indicates "7/8-80UNF-2A" for the main body section. A dimension of .867 MAX DIA is shown for the main body section.

Other Dimensions: A dimension of 1.175 MAX is shown from the left face to the start of the main body. A dimension of 1.155 MAX is shown from the left face to the end of the main body. A dimension of .342 ± .005 is shown from the centerline to the edge of the main body. A note indicates ".188 DIA 2 HOLES" for the main body section. A dimension of .348 MAX is shown from the centerline to the edge of the main body. A note indicates ".135 MAX DIA" for the main body section. A dimension of .78 is shown from the centerline to the edge of the main body. A note indicates "7/8-80UNF-2A" for the main body section. A dimension of .867 MAX DIA is shown for the main body section.

ENVELOPE DRAWING

Initiators

INITIATOR, CARTRIDGE ACTUATED, M28

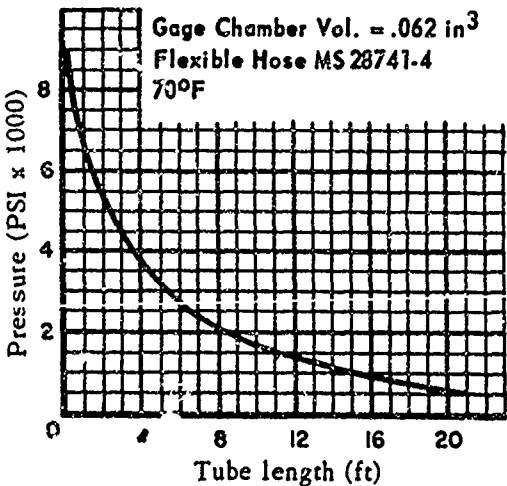
The M28 Initiator, a miniature version of the M5A2 Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M91 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

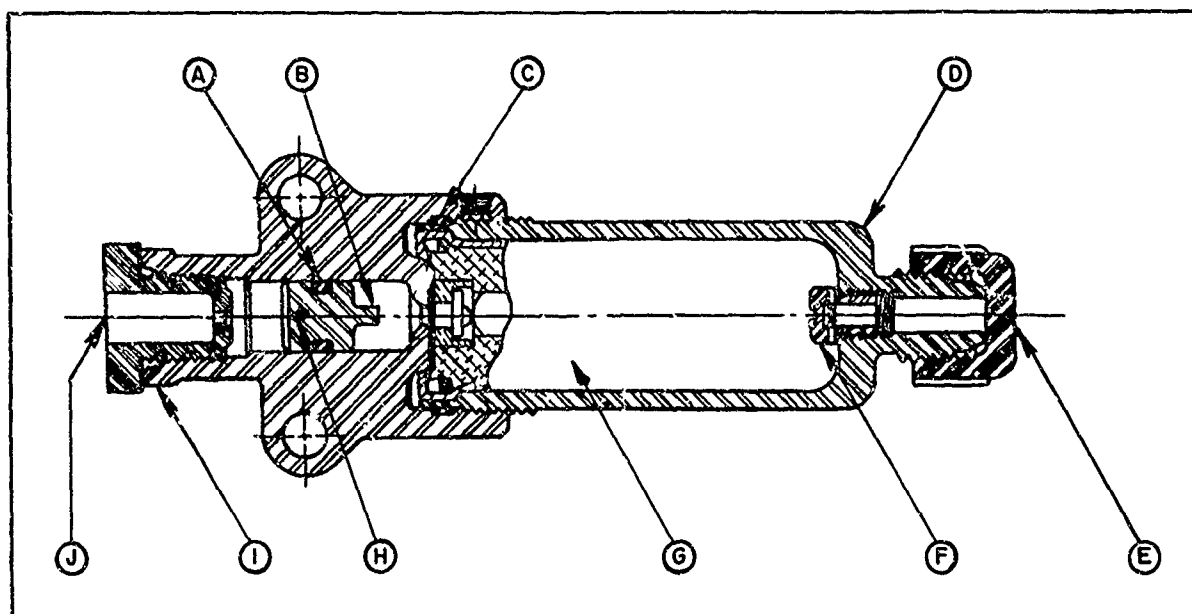
Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.3 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



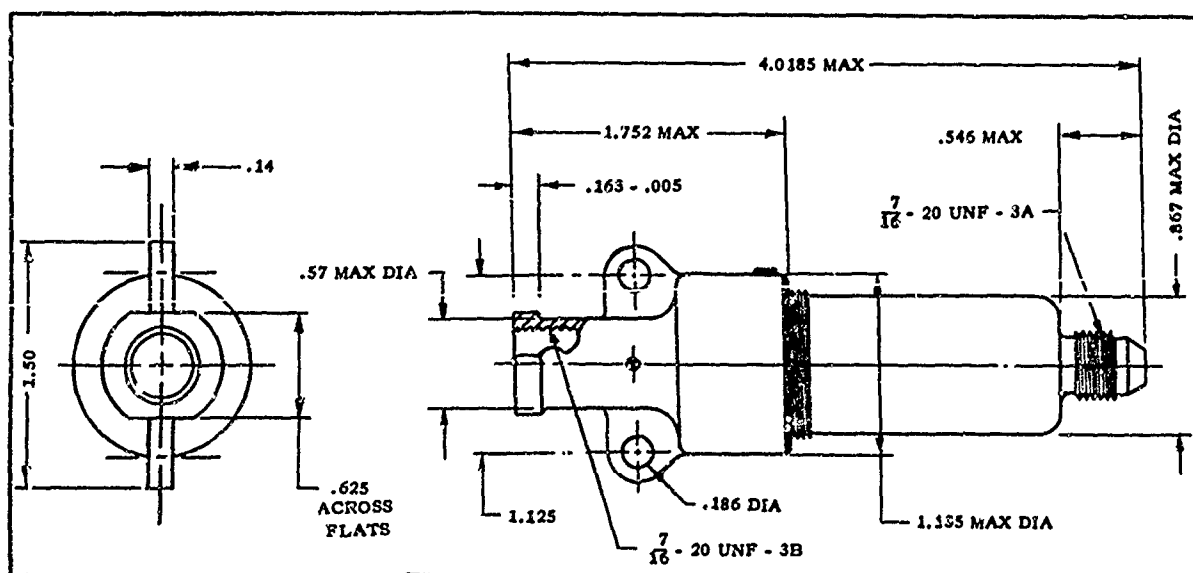
Propellant Actuated Devices

Initiator, Cartridge Actuated, M28



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	F Filter
B Pin, Firing	G Cartridge, Impulse, M9i Assembly
C "O" Ring	H Pin, Shear
D Chamber, Initiator	I Cap, Initiator
E Cap, Shipping	J Plug, Shipping



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M29

The M29 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism, an M73 Cartridge, an integral arming mechanism with a gas intake port and a manual override, and integral mounting lugs. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

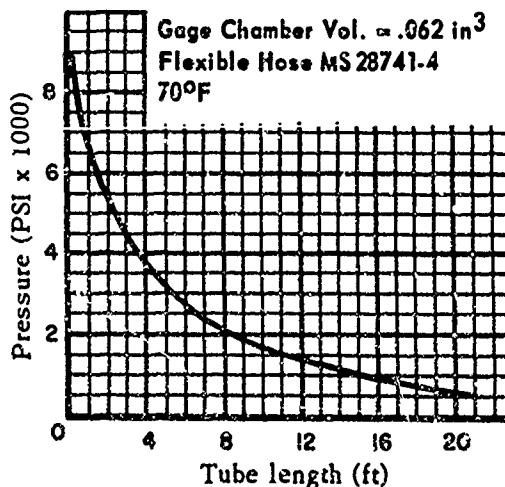
Actuation of this initiator is accomplished when gas pressure supplied by another propellant actuated device is introduced into the intake port of the arming mechanism, causing the arming mechanism to disengage with the preloaded initiator pin. The sequence of actuation events following are the same as those for the conventional mechanical initiator.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

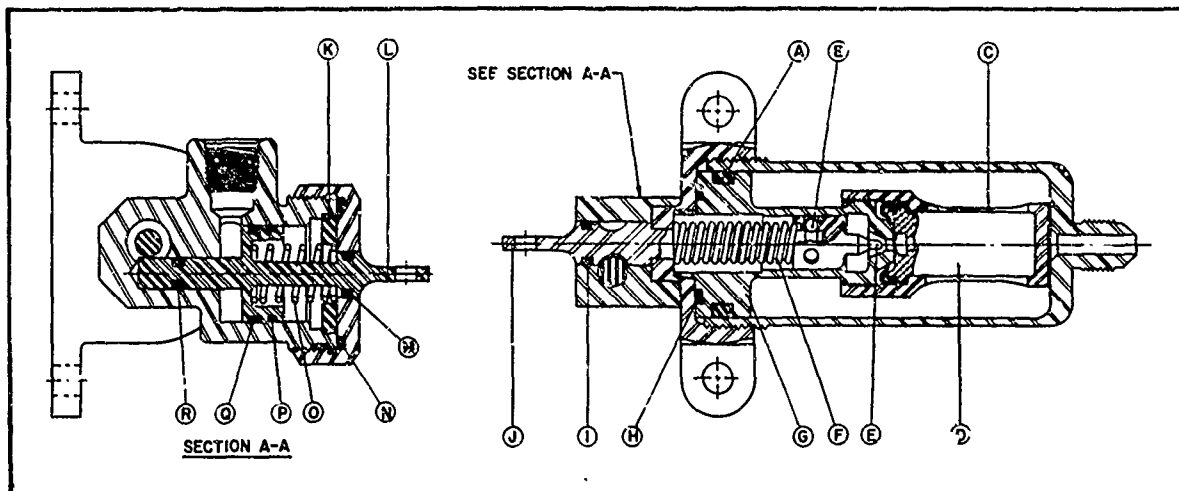
Actuation Method	Gas Pressure w/manual override
Actuation Force	750 psi min
Initiator Pin Preload	40 lbs min
Manual Override Force	25 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	1.75 lbs.

TYPICAL PERFORMANCE



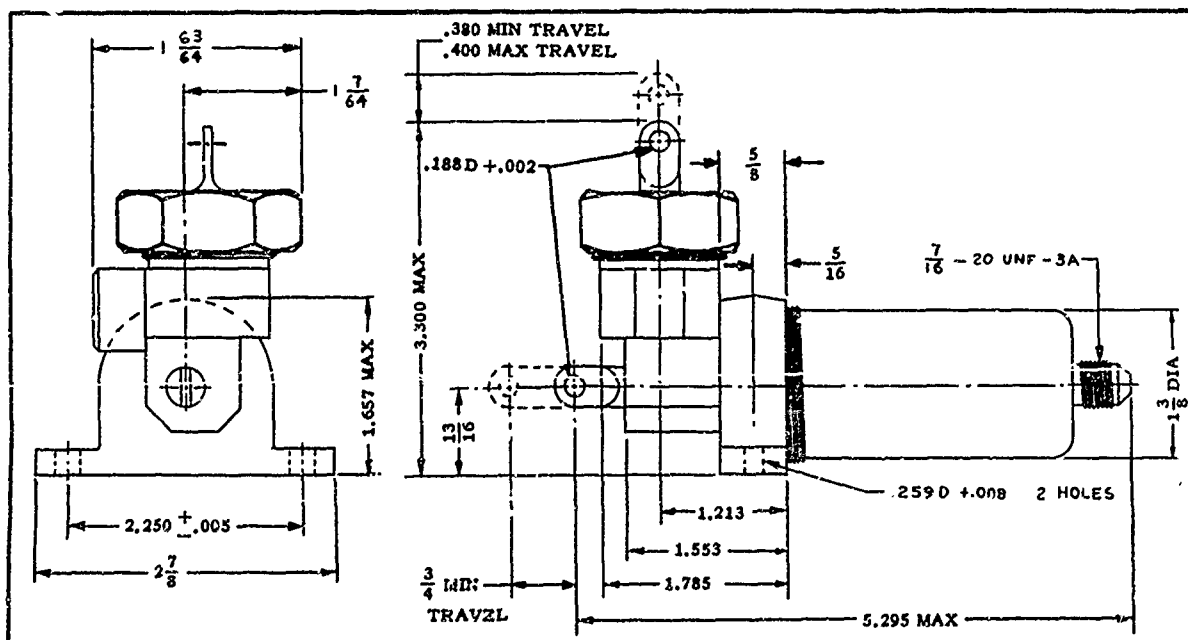
Propellant Actuated Devices

Initiator, Cartridge Actuated, M29



CROSS-SECTION DRAWING

Component	Component
A Gasket	J Pin, Initiator
B Balls (3)	K Stop, Piston
C Retainer, Cartridge	L Piston
D Cartridge, Impulse, M73	M Gasket
E Pin, Firing	N Gasket
F Spring, Initiator	O Spring, Extractor
G Housing, Firing Pin	P Ring, Locking
H Gasket	Q Gasket
I Gasket	R Gasket



ENVELOPE DRAWING

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M30A1

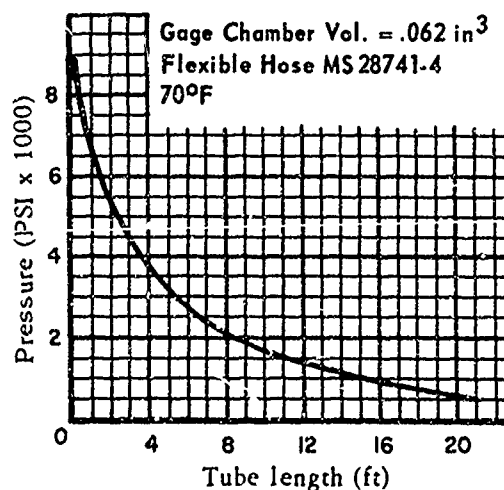
The M30A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M70 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M5 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

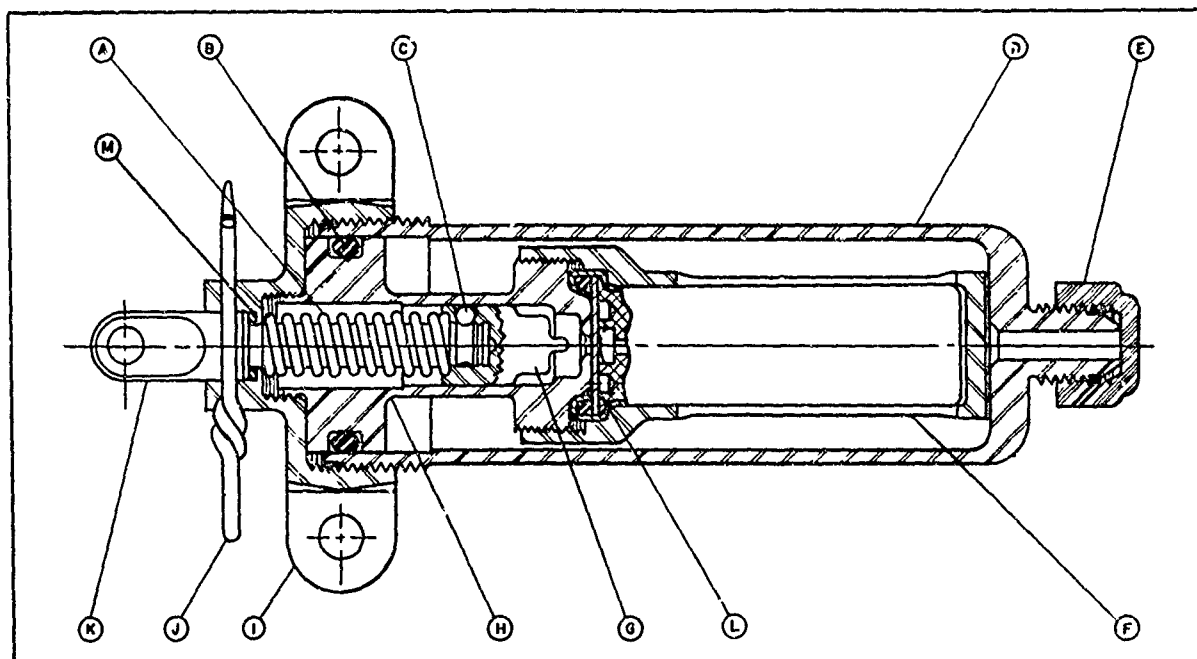
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	2.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M30A1



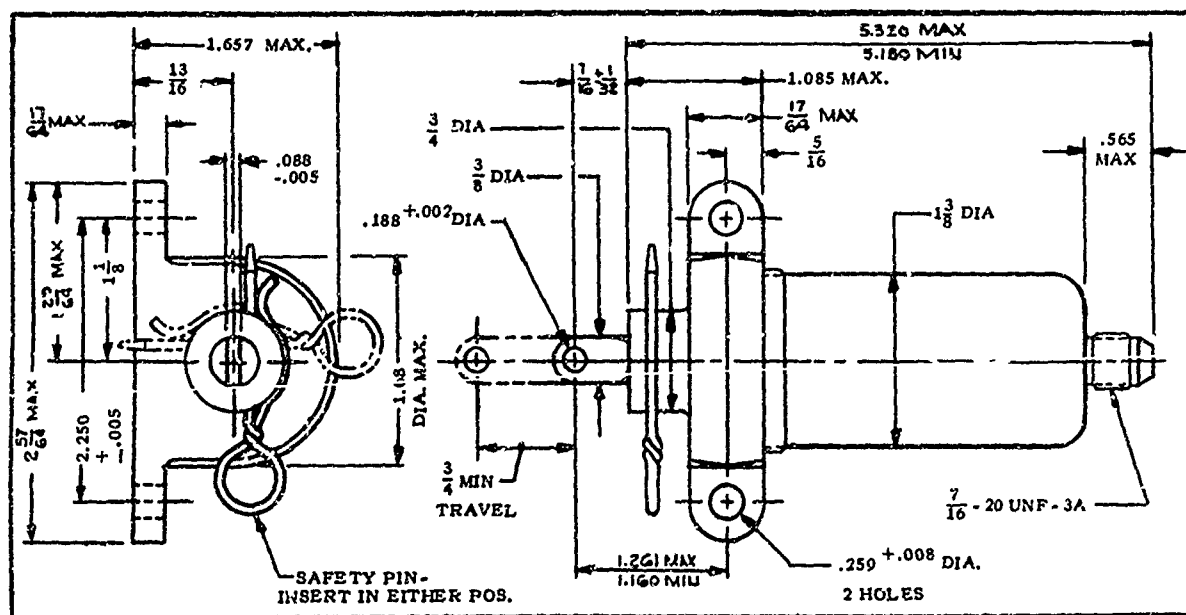
CROSS-SECTION DRAWING

Component

- A Spring, Initiator
- B "O" Ring
- C Balls (3)
- D Chamber, Initiator
- E Cap, Shipping
- F Retainer, Cartridge
- G Pin, Firing

Component

- H Housing, Firing Pin
- I Cap
- J Pin, Safety
- K Pin, Initiator
- L Cartridge, Initiator, Delay, M70 Assembly
- M Seal



ENVELOPE DRAWING

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M31

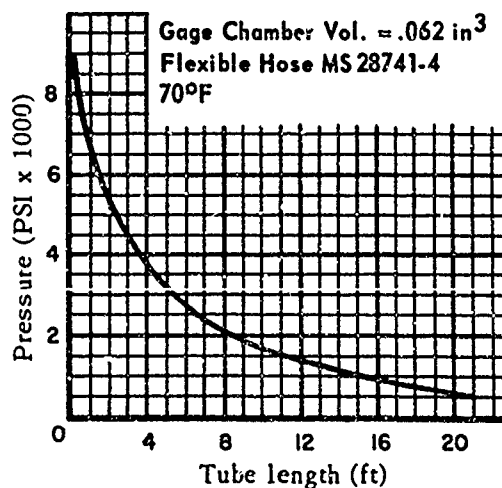
The M31 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M93 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

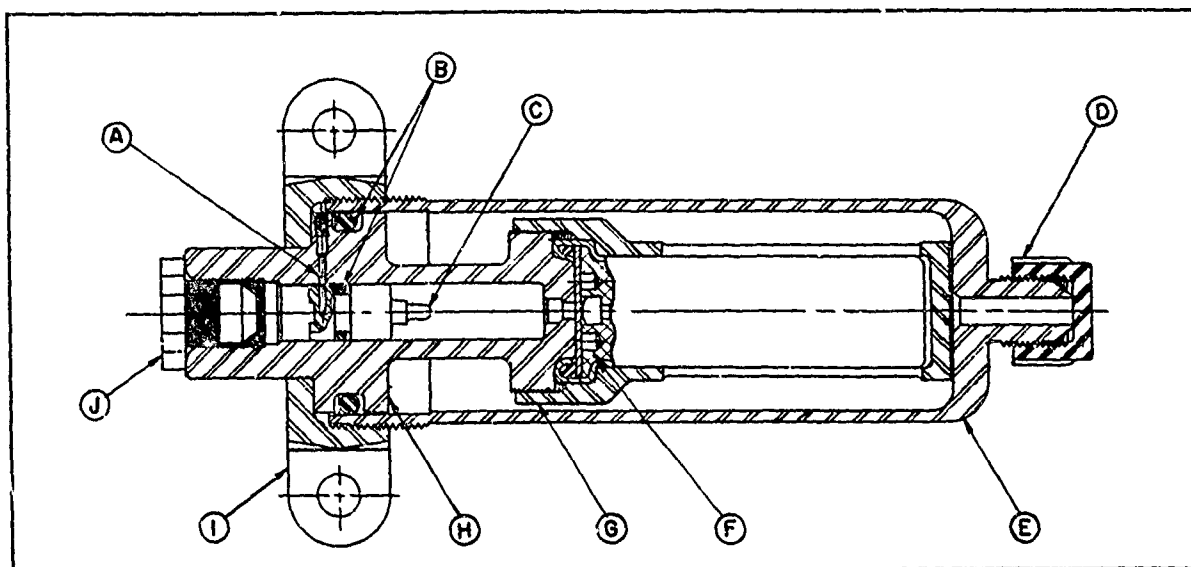
Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	1.0 second

TYPICAL PERFORMANCE



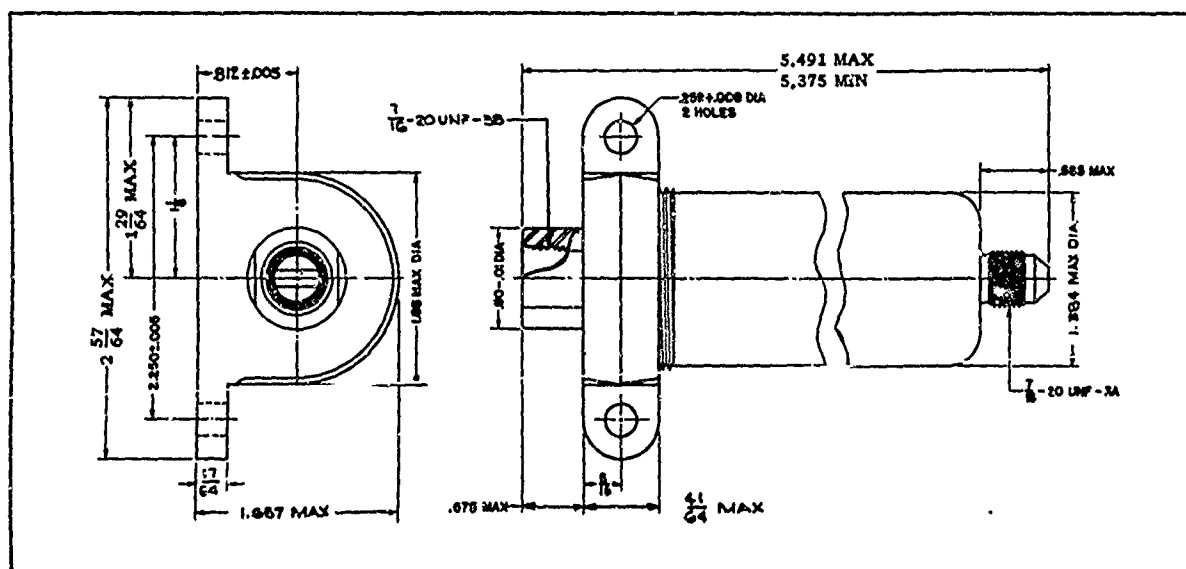
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M31



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	F Cartridge, Impulse
B "O" Ring	Delay, M93 Assembly
C Pin, Firing	G Retainer, Cartridge
D Cap, Shipping	H Housing, Firing Pin
E Chamber, Initiator	I Cap
	J Plug, Shipping



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M32A1

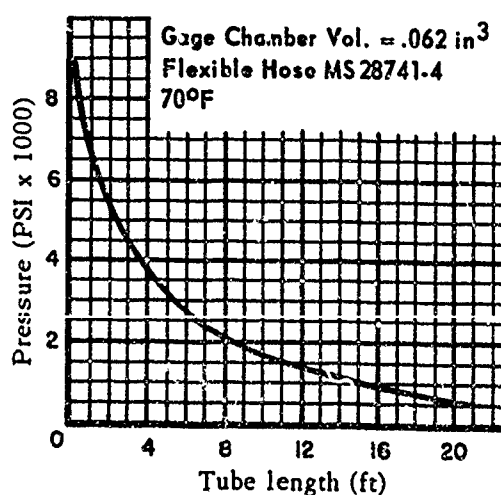
The M32A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M93 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	1.0 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE

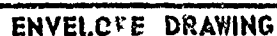


Initiator, Cartridge Actuated, Delay, M32A1



Component

- H Housing, Firing Pin
I Cap
J Pin. Safety
K Pin, Initiator
L Cartridge,
Delay, M93 Assembly
M Seal



Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M33

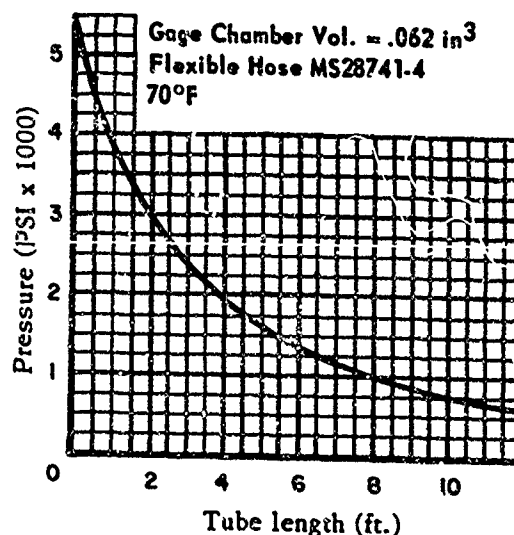
The M33 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M71 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M8 Delay Element contained in the cartridge burns for 1 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

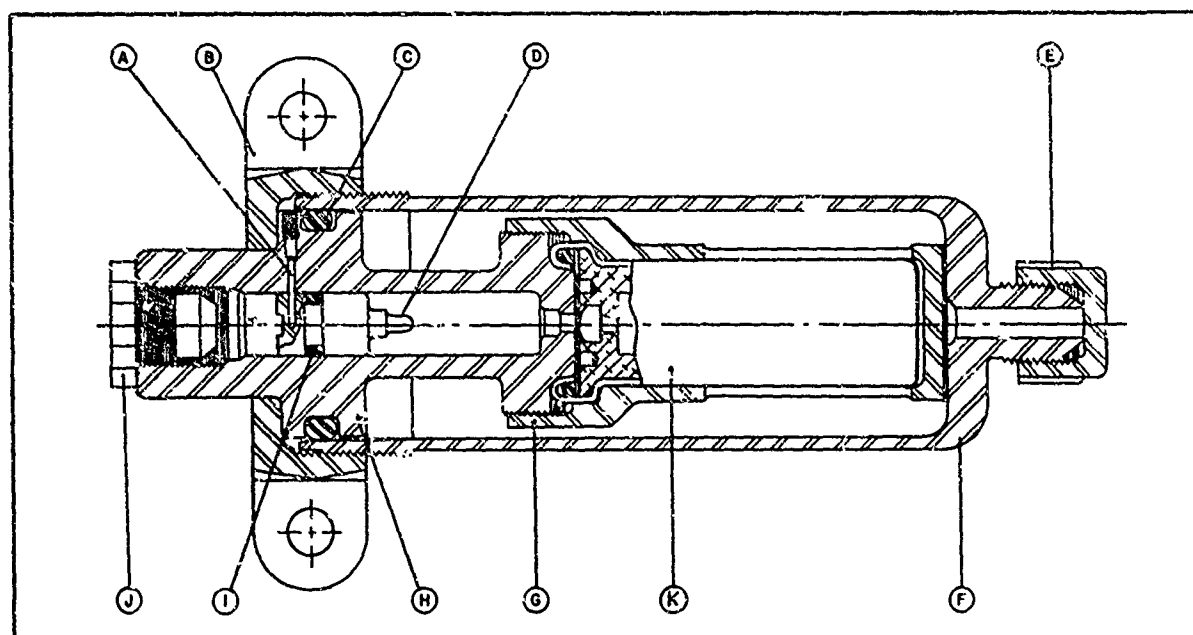
Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	1.0 second

TYPICAL PERFORMANCE



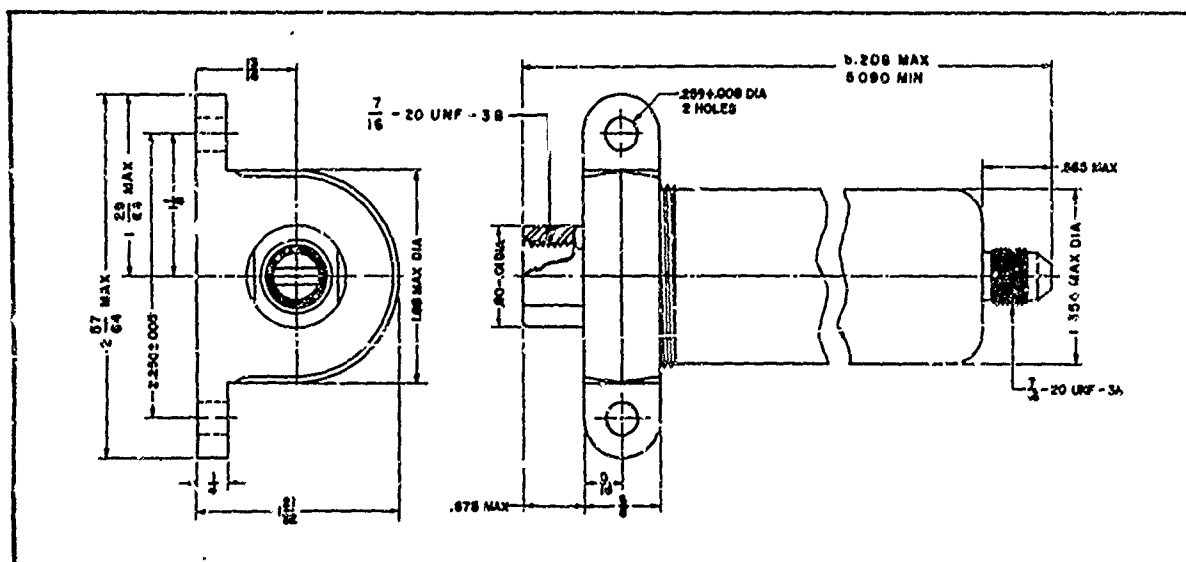
Promellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M33



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	G Retainer, Cartridge
B Cap	H Housing, Firing Pin
C "O" Ring	I "O" Ring
D Pin, Firing	J Plug, Shipping
E Cap, Shipping	K Cartridge, Initiator, Delay, M71 Assembly
F Chamber, Initiator	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M42

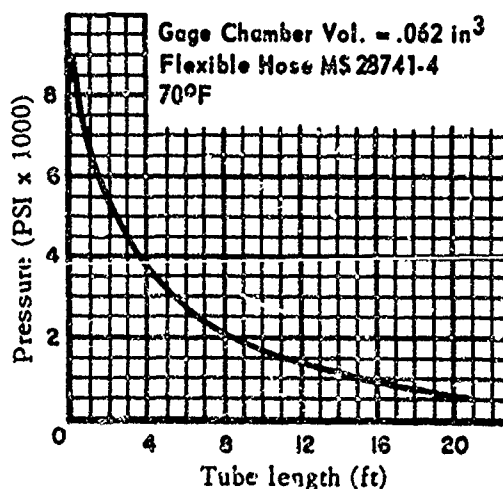
The M42 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M13 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

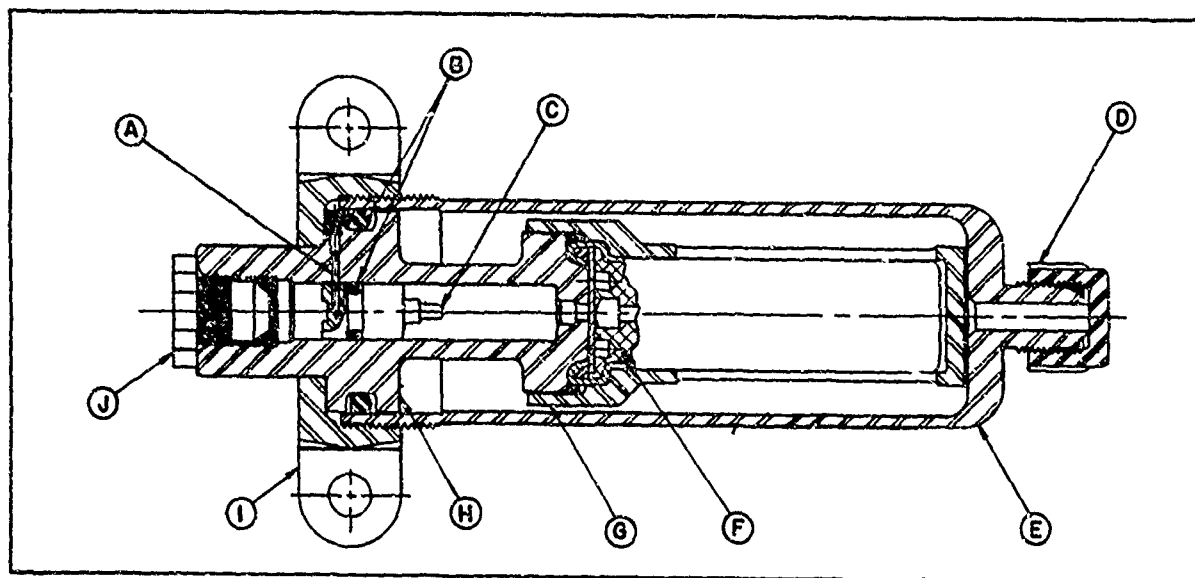
Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	3.0 seconds

TYPICAL PERFORMANCE



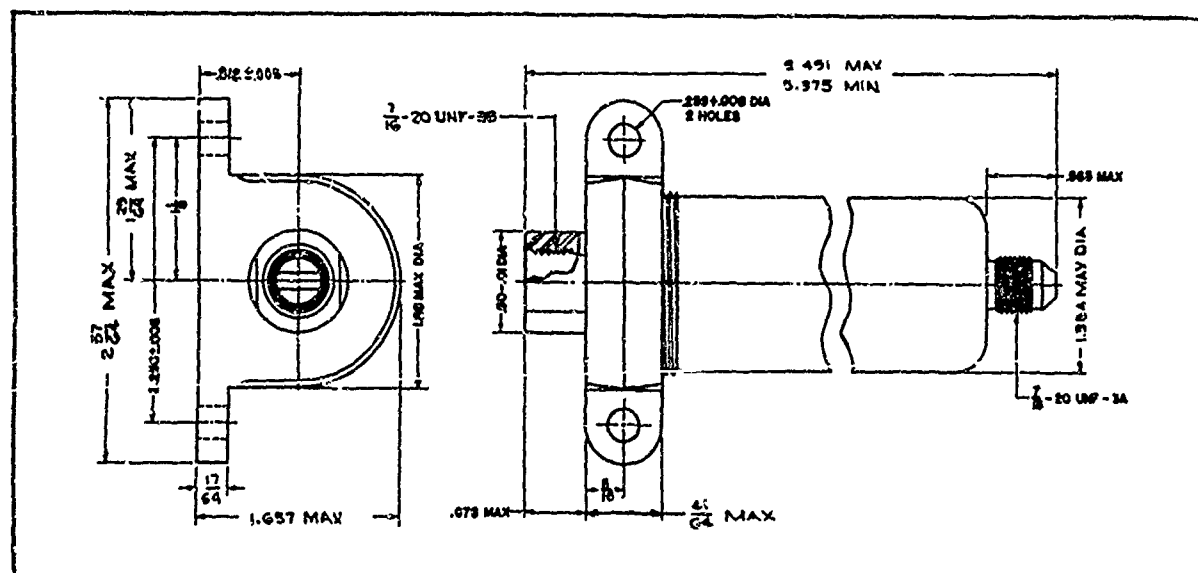
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M42



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	F Cartridge, Initiator, Delay, M113 Assembly
B "O" Ring	G Retainer, Cartridge
C Pin, Firing	H Housing, Firing Pin
D Cap, Shipping	I Cap
E Chamber, Initiator	J Plug, Shipping



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M43A1

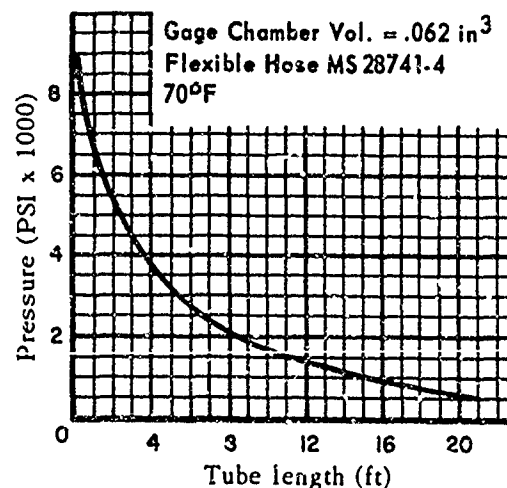
The M43A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M113 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

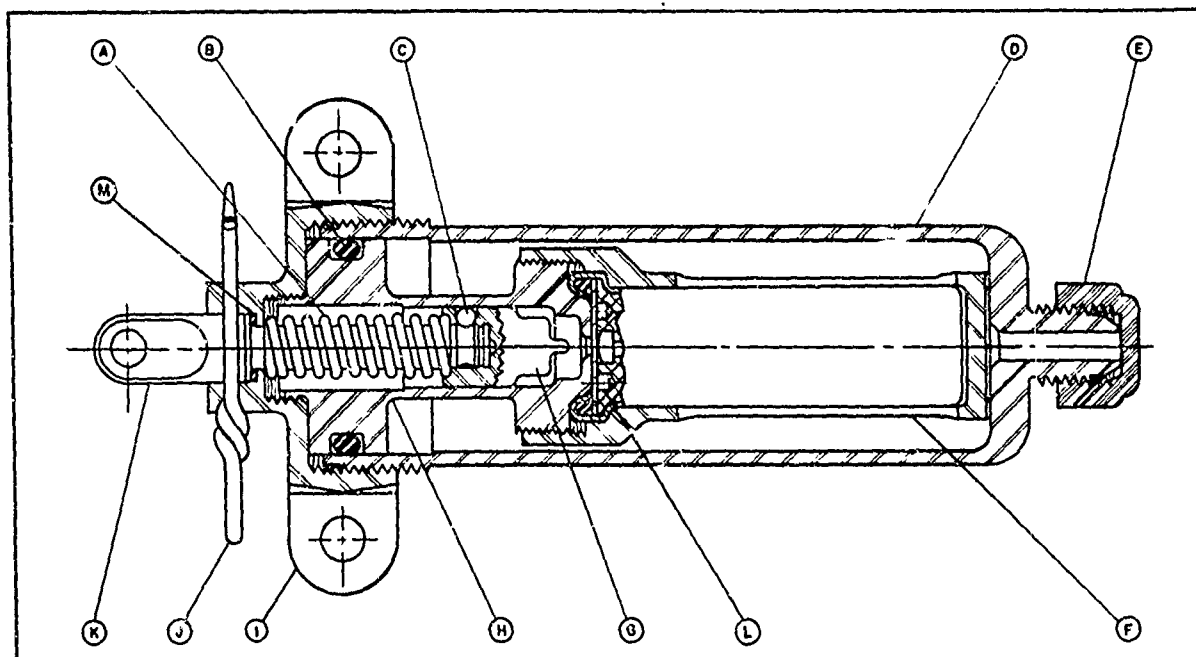
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M43A1



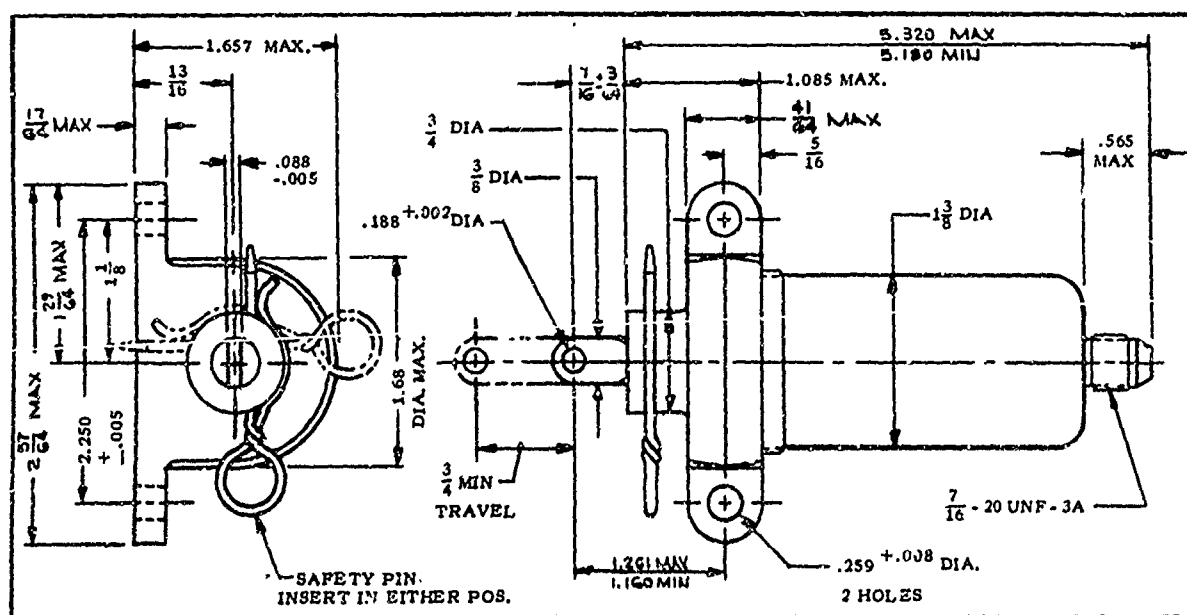
CROSS-SECTION DRAWING

Component

- A Spring, Initiator
- B "O" Ring
- C Balls (3)
- D Chamber, Initiator
- E Cap, Shipping
- F Retainer, Cartridge
- G Pin, Firing

Component

- H Housing, Firing Pin
- I Cap
- J Pin, Safety
- K Pin, Initiator
- L Cartridge, Delay, M93 Assembly
- M Seal



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M44

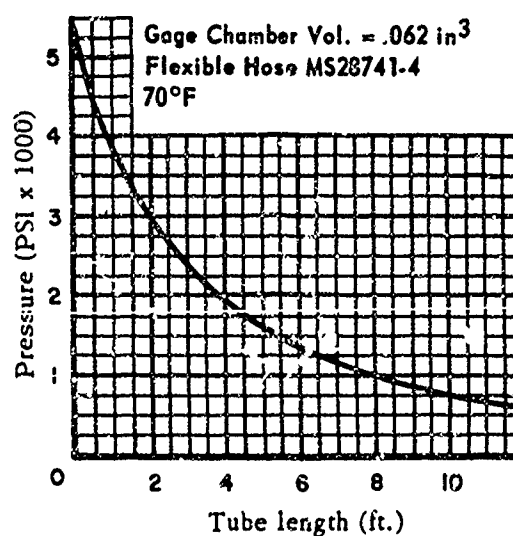
The M44 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M114 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

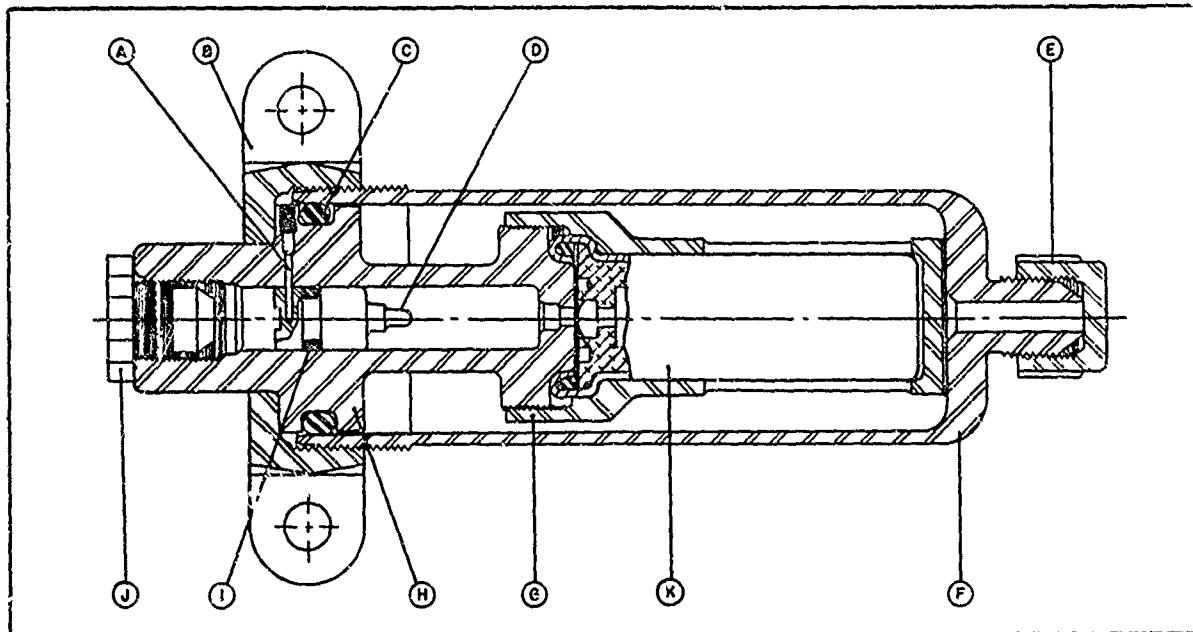
Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Delay Time	3.0 seconds

TYPICAL PERFORMANCE



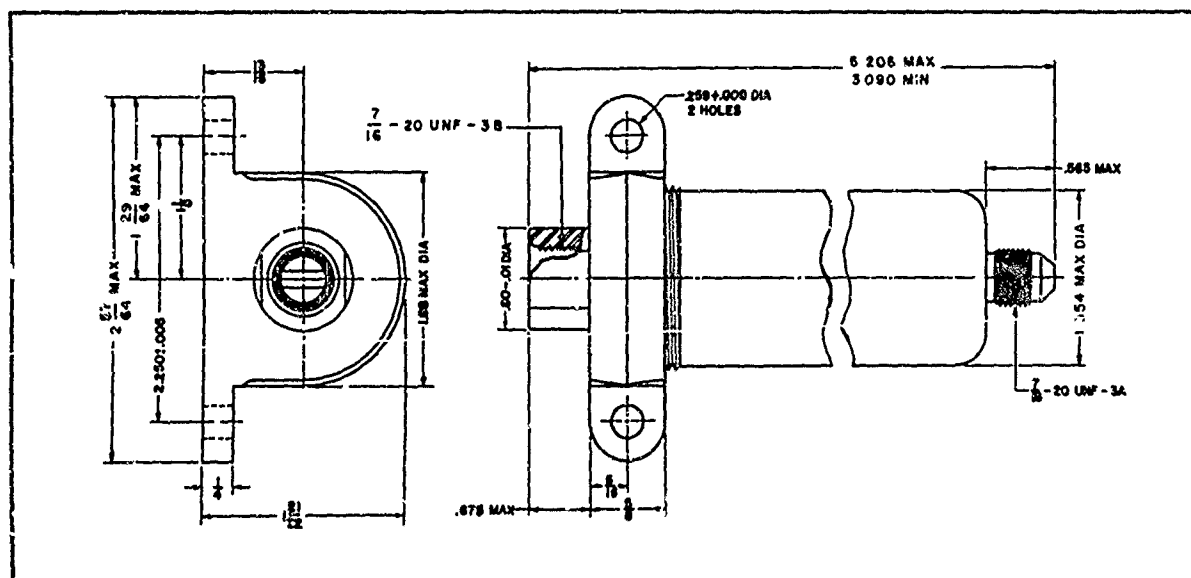
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M44



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	G Retainer, Cartridge
B Cap	H Housing, Firing Pin
C "O" Ring	I "O" Ring
D Pin, Firing	J Plug, Shipping
E Cap, Shipping	K Cartridge, Initiator, Delay, M114 Assembly
F Chamber, Initiator	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR CARTRIDGE ACTUATED, DELAY, M45A1

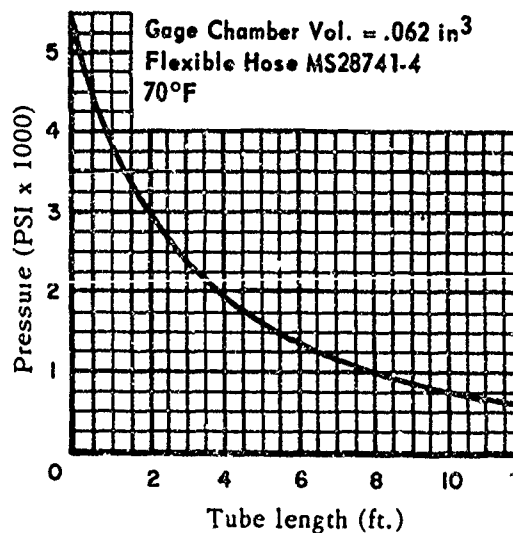
The M45A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M114 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M13 Delay Element contained in the cartridge burns for 3 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

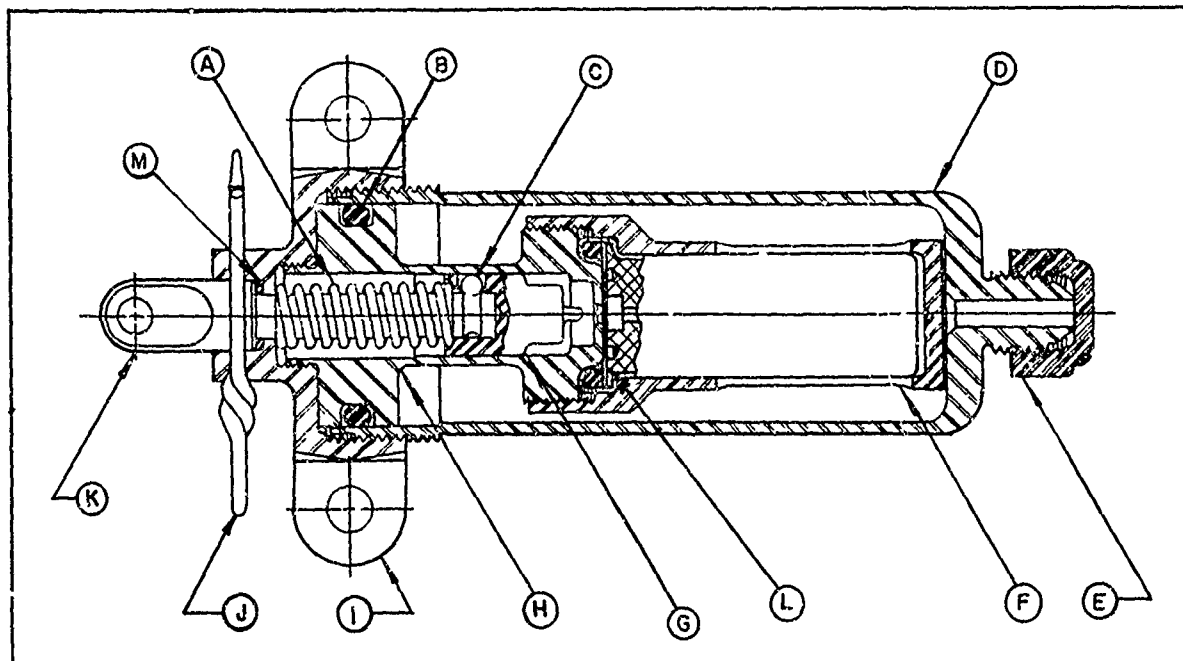
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	3.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



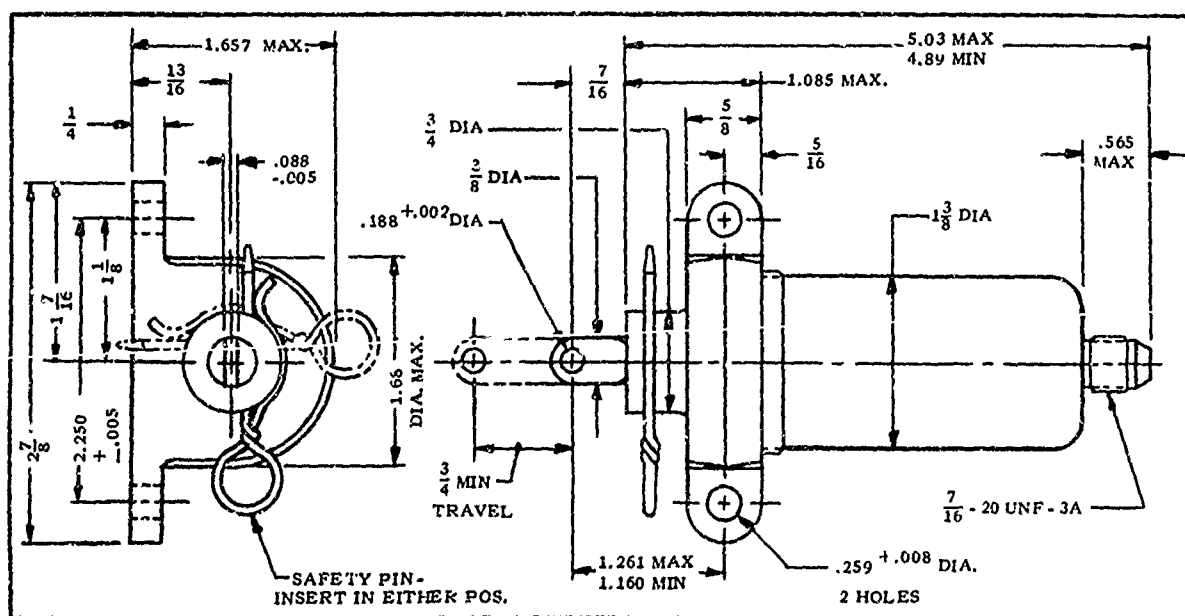
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M45A1



CROSS-SECTION DRAWING

Component	Component
A Spring, Initiator	H Housing, Firing Pin
B "O" Ring	I Cap
C Ball	J Pin, Safety
D Chamber, Initiator	K Pin, Initiator
E Cap, Shipping	L Cartridge, Initiator, Delay, M114 Assembly
F Retainer, Cartridge	M Seal
G Pin, Firing	



Propellant Actuated Devices

Initiators

INITIATOR CARTRIDGE ACTUATED, DELAY, M49A1

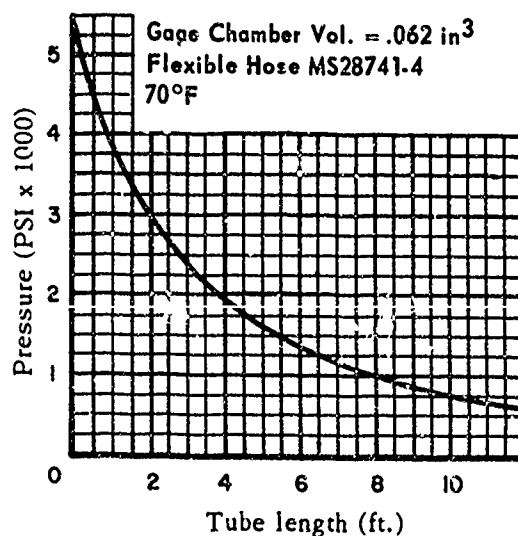
The M49A1 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M90 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M14 Delay Element contained in the cartridge burns for 0.3 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

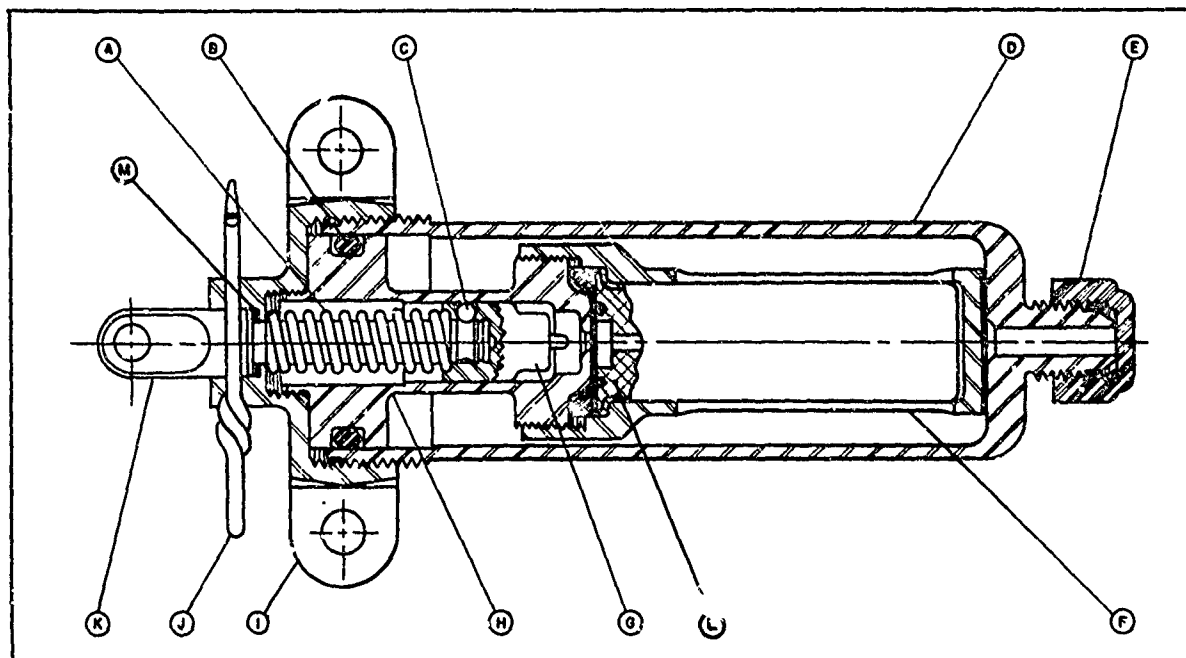
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	1.0 lb.
Delay Time	0.3 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE



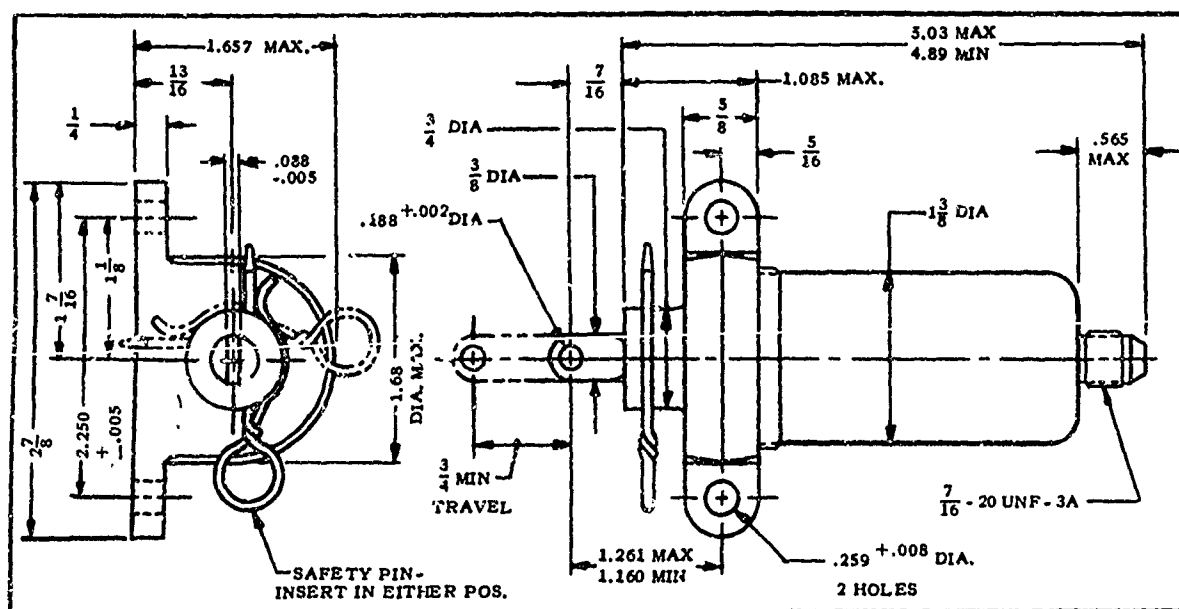
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M49A1



CROSS-SECTION DRAWING

Component	Component
A Spring, Initiator	H Housing, Firing Pin
B "O" Ring	I Cap
C Ball	J Pin, Safety
D Chamber, Initiator	K Pin, Initiator
E Cap, Shipping	L Cartridge, Initiator, Delay, M90 Assembly
F Retainer, Cartridge	M Seal
G Pin, Firing	



Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M51

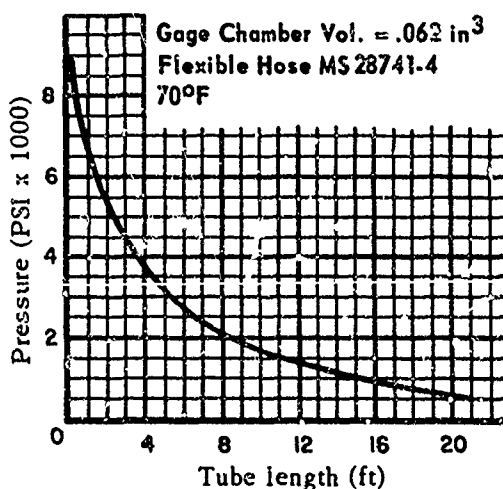
The M51 Delay Initiator consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M89 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

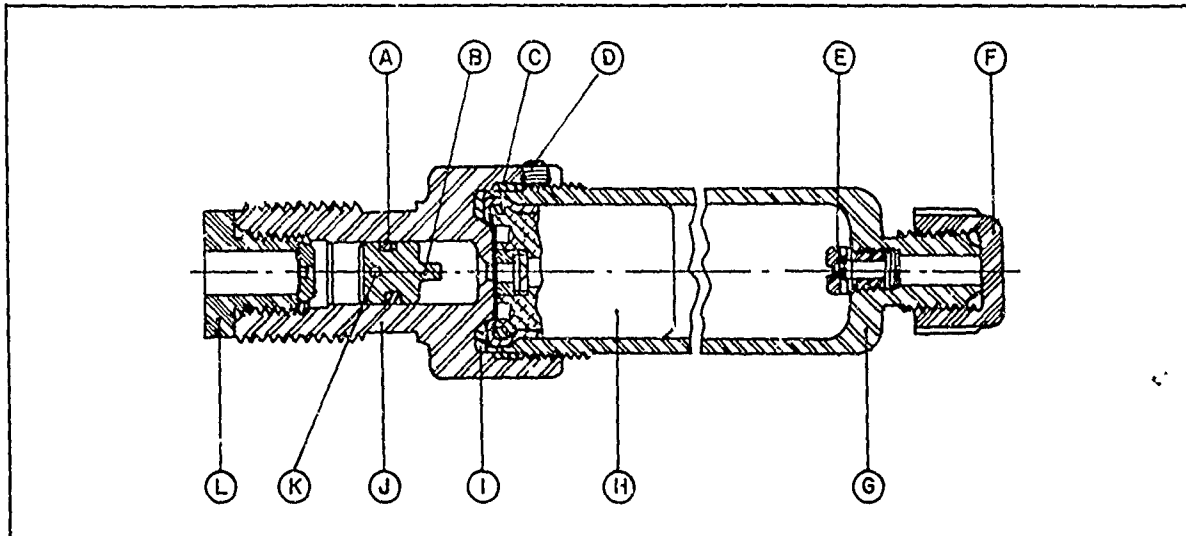
Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	2.0 seconds
Mounting	Integral Threads

TYPICAL PERFORMANCE



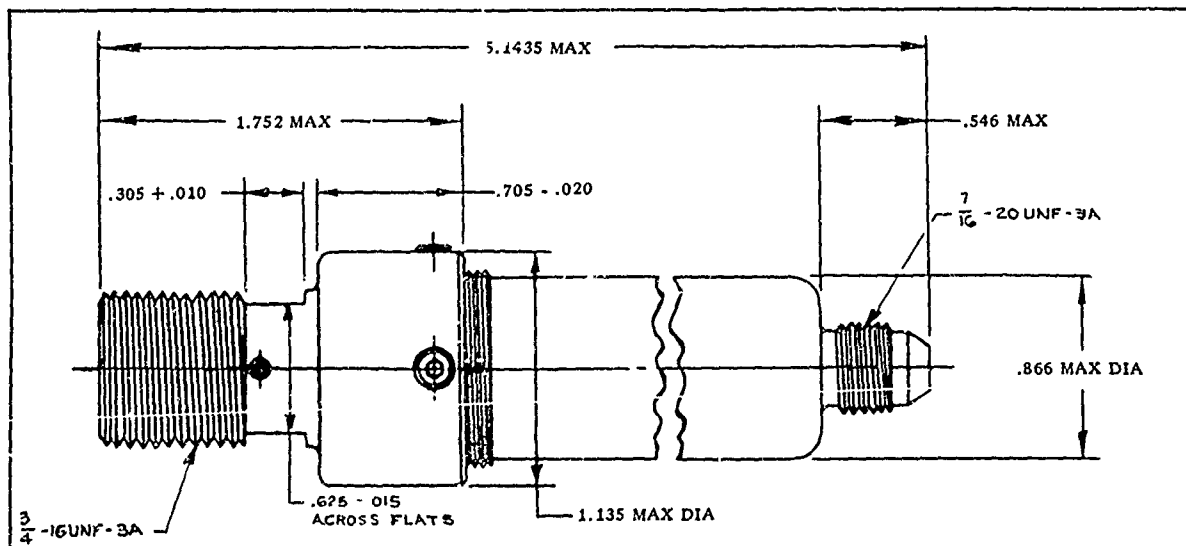
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M51



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	H Cartridge, Initiator, Delay, M89 Assembly
B Pin, Firing	I "O" Ring
C "O" Ring	J Cap, Initiator
D Screw, Set	K Pin, Shear
E Filter	L Plug, Shipping
F Cap, Shipping	
G Chamber, Initiator	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M52

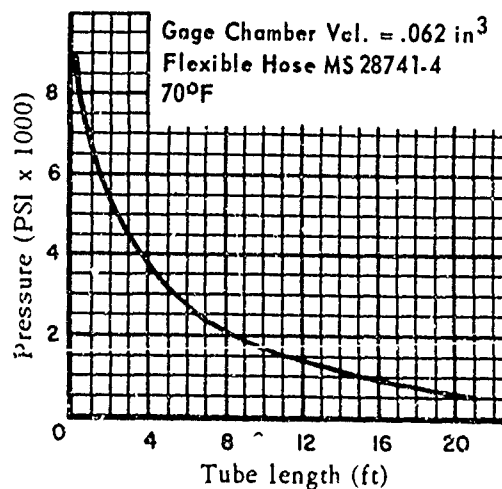
The M52 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M128 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M27 Delay Element contained in the cartridge, burns for 5 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

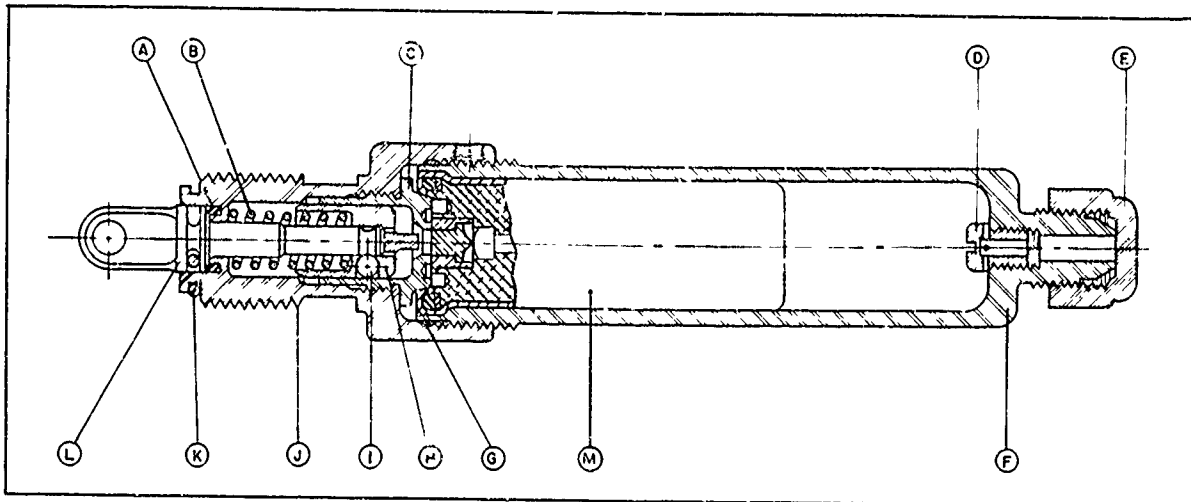
Actuation Method	Mechanical
Actuation Force	40 lb. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	5.0 seconds
Mounting	Integral Threads

TYPICAL PERFORMANCE



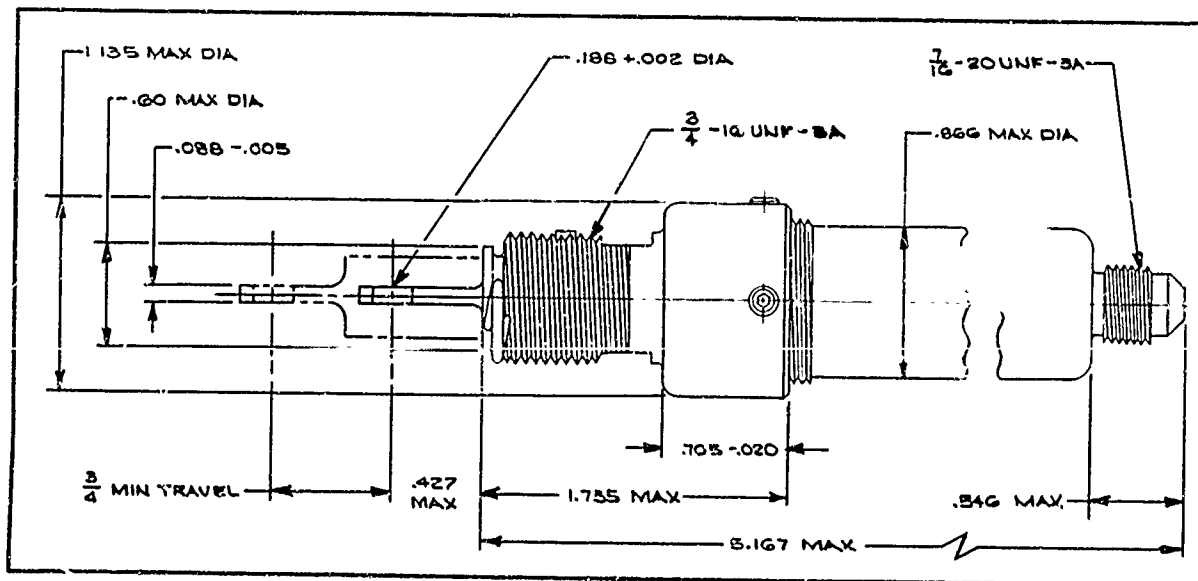
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M52



CROSS-SECTION DRAWING

Component	Component
A Seal	H Pin, Firing
B Spring, Initiator	I Ball
C Housing, Firing Pin	J Cap, Initiator
D Filter	K Pin, Safety
E Cap, Shipping	L Pin, Impulse
F Chamber, Initiator	M Cartridge, Delay, M128
G "O" Ring	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M53

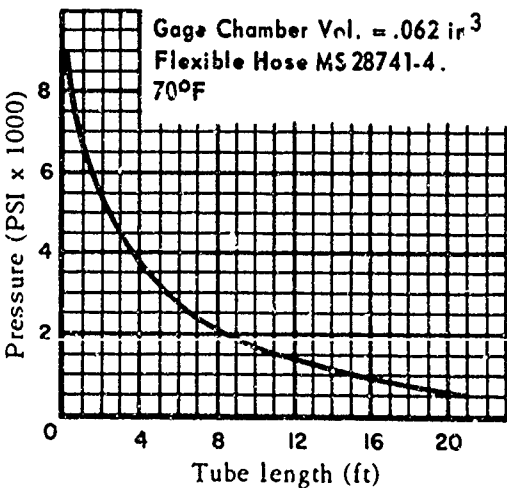
The M53 Initiator, a miniature version of the M3A2 Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M91 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

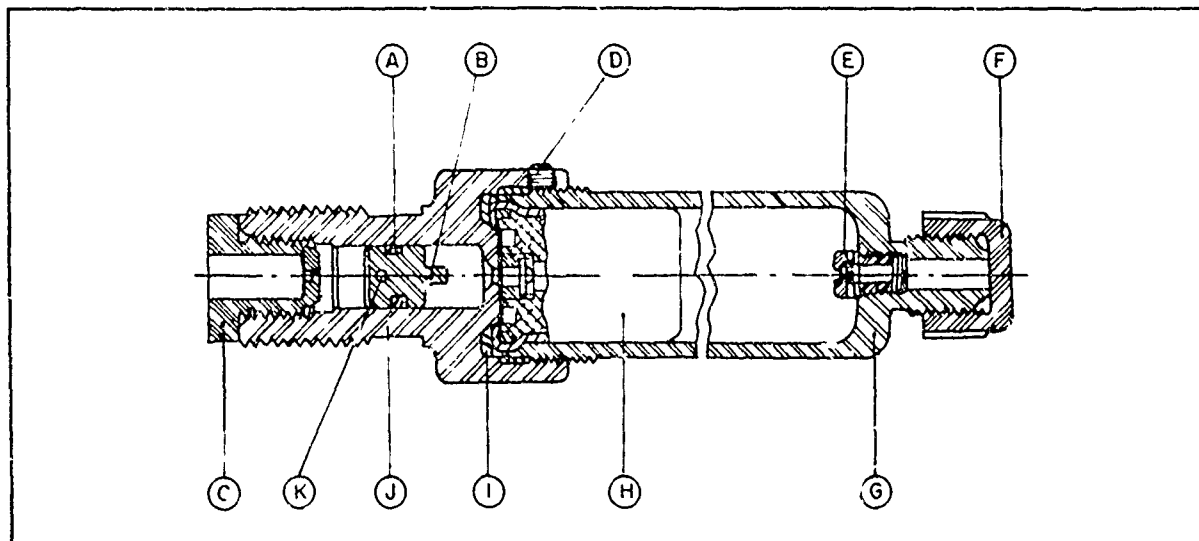
Actuation Method	Gas Pressure
Actuation Force	750 psi, min
Temperature Limits	-65° to +160°F
Assembled Weight	0.33 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



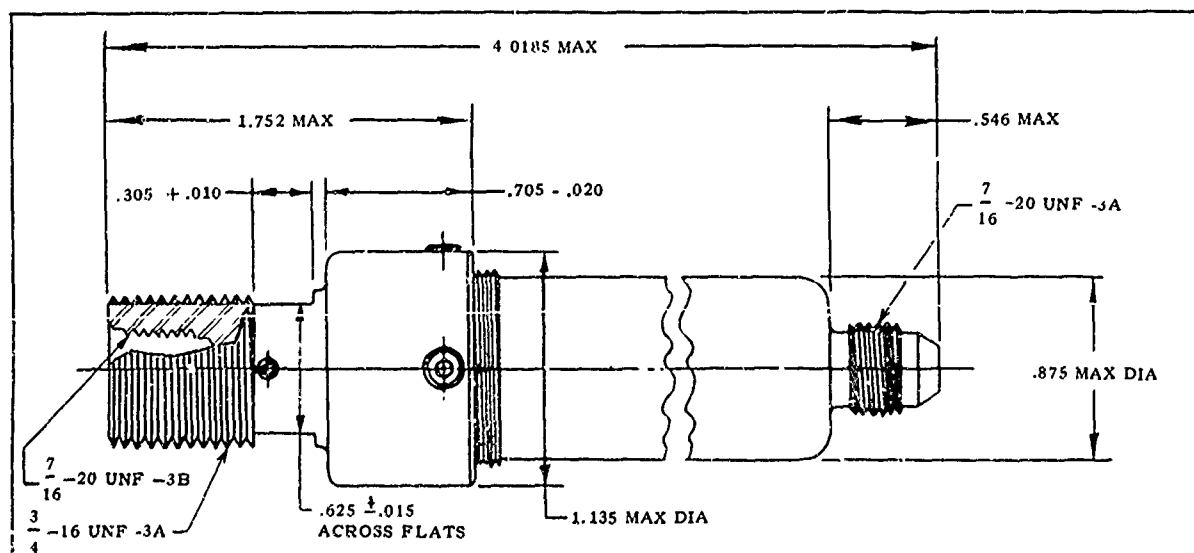
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M53



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Chamber, Initiator
B Pin, Firing	H Cartridge, Impulse
C Plug, Shipping	M91 Assembly
D Screw, Set	I "O" Ring
E Filter	J Cap, Initiator
F Cap, Shipping	K Pin, Shear



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M54

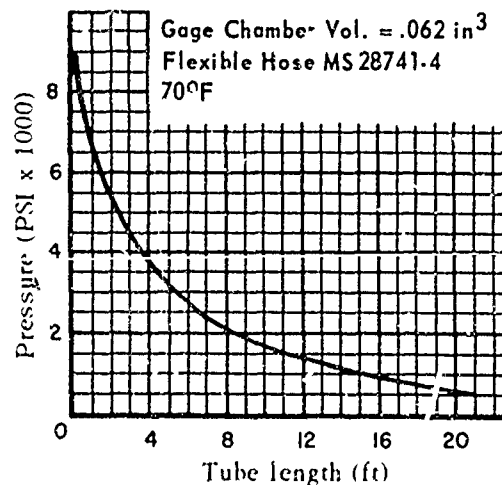
The M54 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M128 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M27 Delay Element contained in the cartridge, burns for 5 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

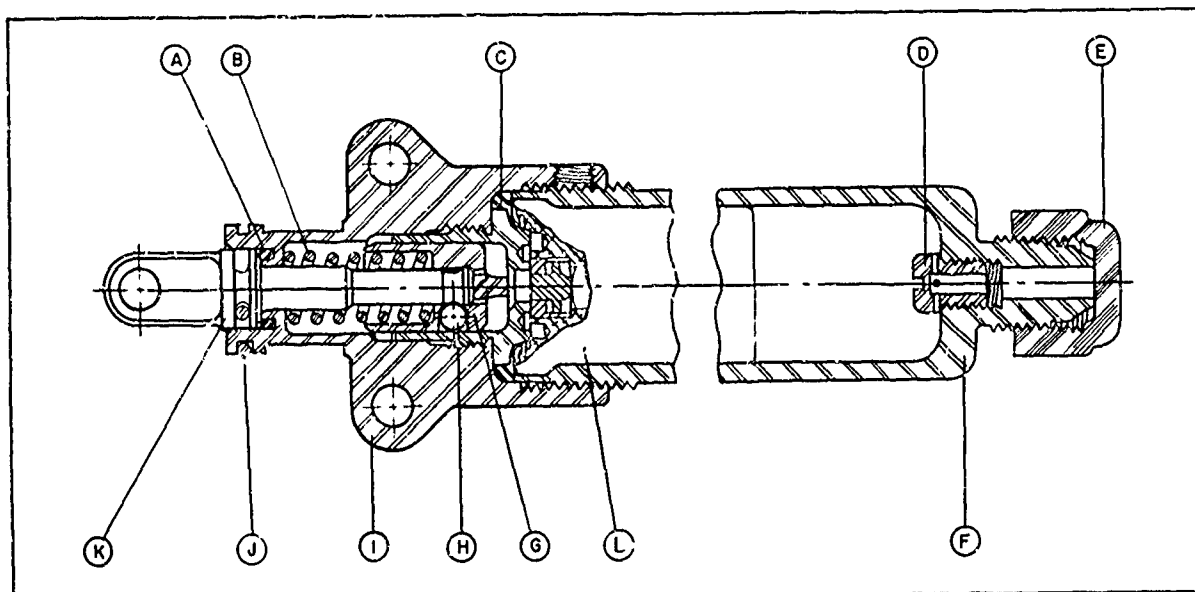
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	5.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



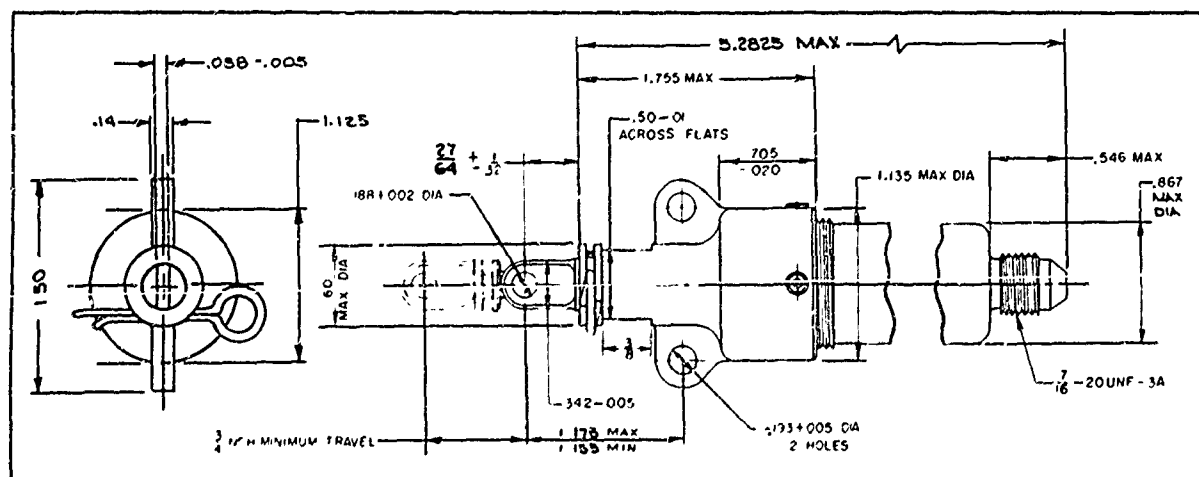
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M54



CROSS-SECTION DRAWING

Component	Component
A Seal	G Pin, Firing
B Spring, Initiator	H Balls (3)
C Housing, Firing Pin	I Cap, Initiator
D Filter	J Pin, Safety
E Cap, Shipping	K Pin, Initiator
F Chamber, Initiator	L Cartridge, Delay, M128



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM64

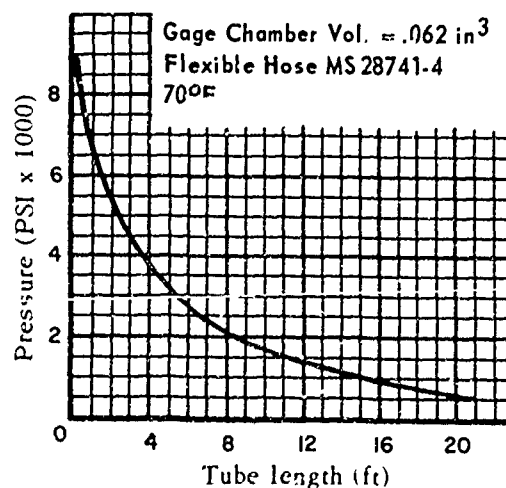
The XM64 Delay Initiator consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM148 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM44 Delay Element contained in the cartridge burns for 3/4 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

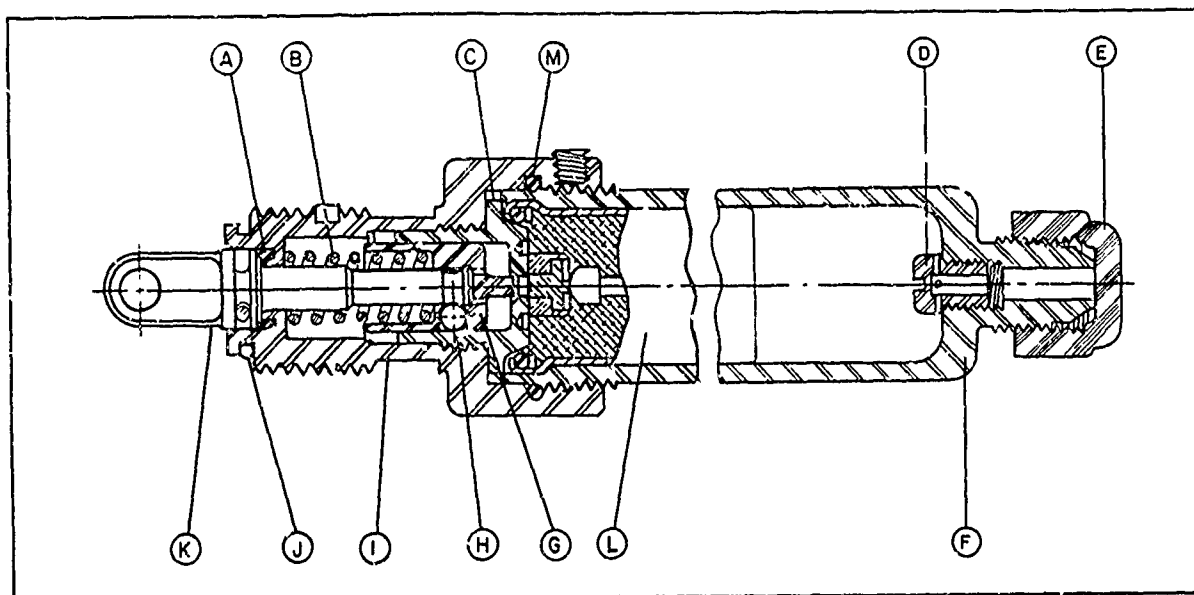
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	3/4 second
Mounting	Integral Threads

TYPICAL PERFORMANCE



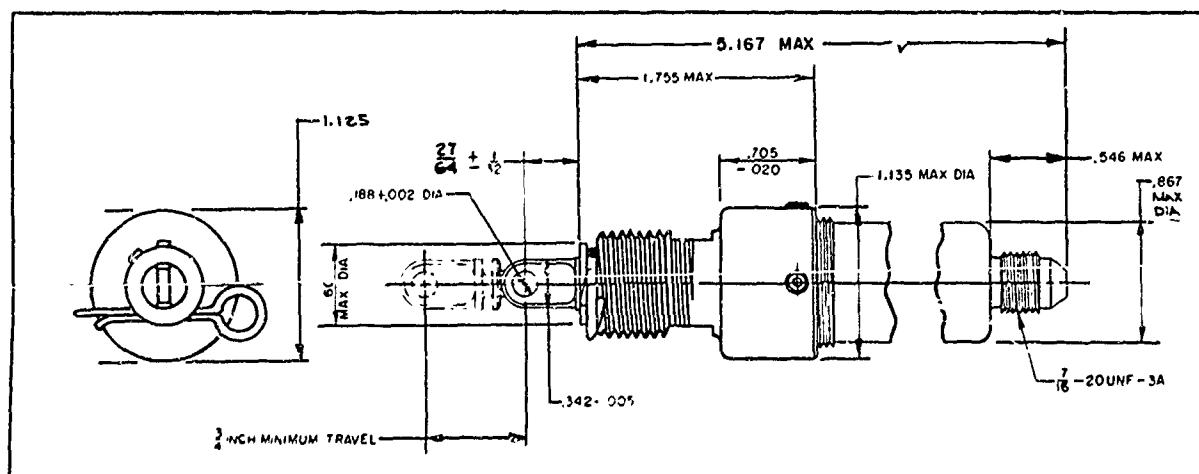
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM164



CROSS-SECTION DRAWING

Component	Component
A Seal	G Pin, Firing
B Spring, Initiator	H Balls (3)
C Housing, Firing Pin	I Cap, Initiator
D Filter	J Pin, Safety
E Cap, Shipping	K Pin, Initiator
F Chamber, Initiator	L Cartridge, Initiator, XM148
	M "O" Ring



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M72

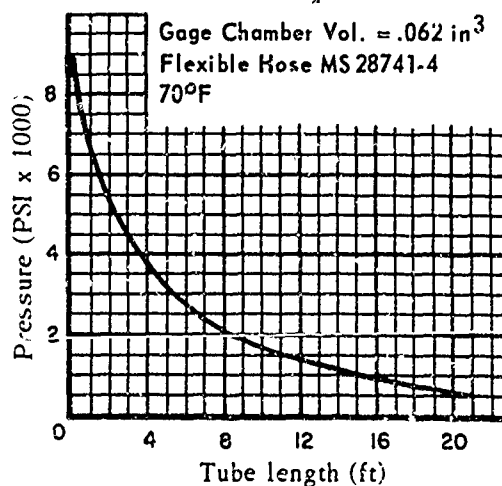
The M72 Delay Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M155 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M28 Delay Element contained in the cartridge burns for 1/2 second, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

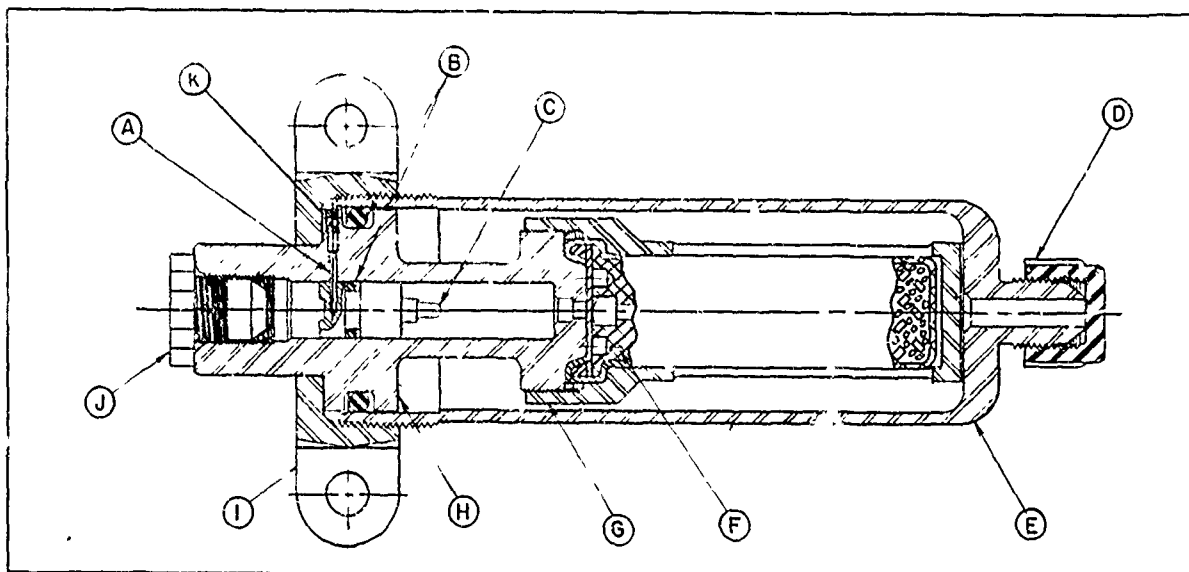
Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +200° F
Assembled Weight	1.0 lb.
Delay Time	1/2 second
Mounting	Integral Lugs

TYPICAL PERFORMANCE



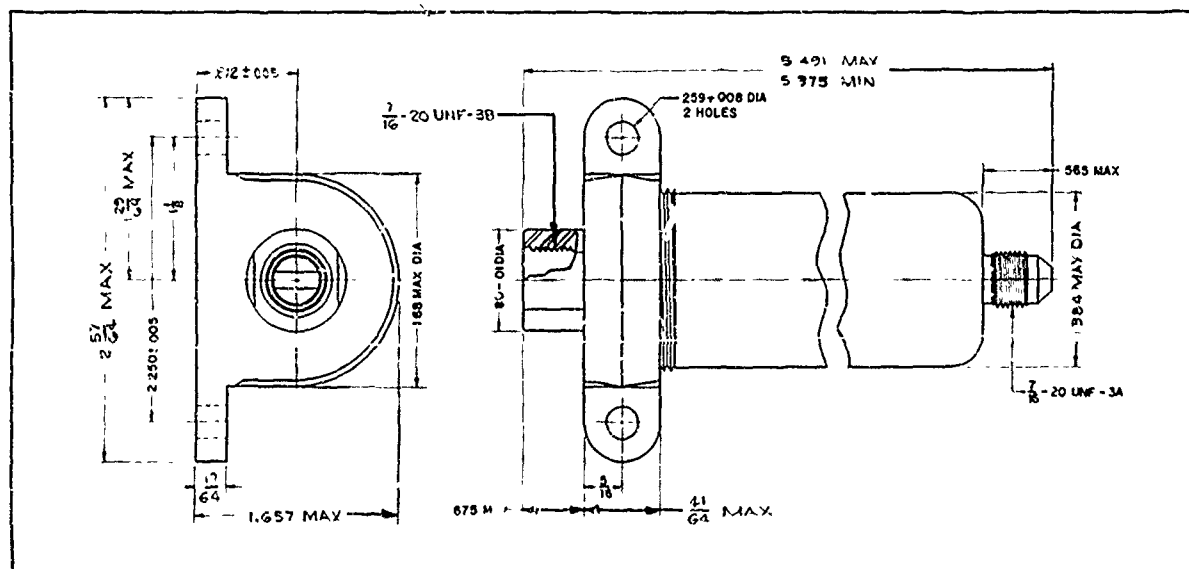
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M72



CROSS-SECTION DRAWING

Component	Component
A Pin, Shear	F Cartridge, Initiator, Delay, M155 Assembly
B "O" Ring	G Retainer, Cartridge
C Pin, Firing	H Housing, Firing Pin
D Cap, Shipping	I Cap
E Chamber, Initiator	J Plug, Shipping
	K Set Screw



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M80

The M80 Initiator is a sealed M9 type Initiator which restricts toxic gas leakage to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a gas pressure actuated firing mechanism, a chamber and end cap with a pressure outlet port incorporating a standard pressure fitting and an M69 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

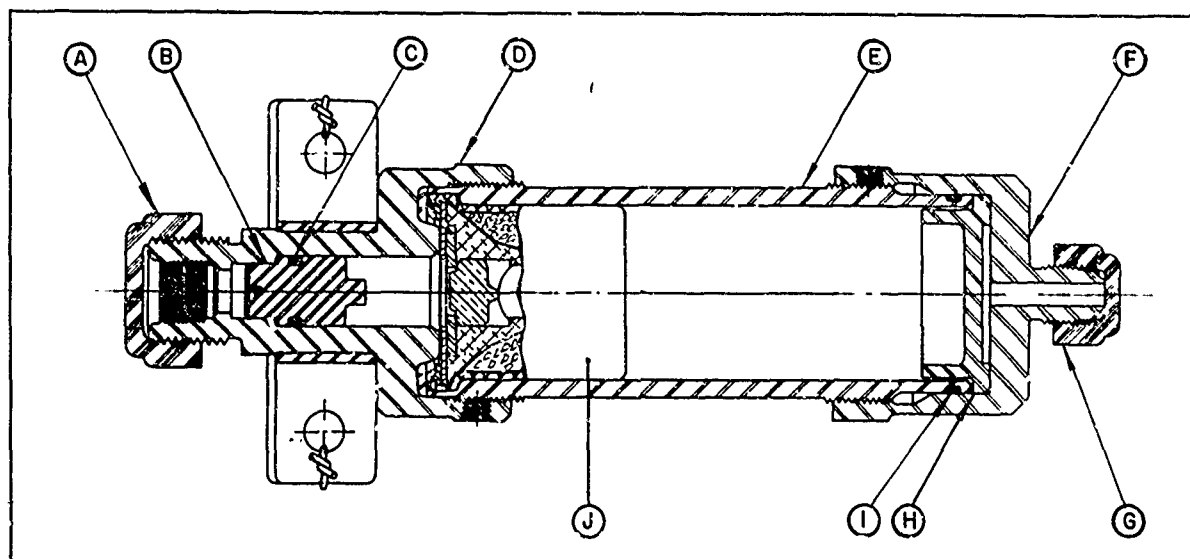
Upon cartridge function, the gas produced by burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device. The M80 Initiator is capable of delivering to an .062 in³ terminal chamber volume at the end of a 30 foot length of MS28741-4 hose, pressure within the limits of 1000 psi minimum and 3000 psi maximum.

PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min.
Temperature Limits	-65°F to +160°F
Assembled Weight	3.2 lbs.

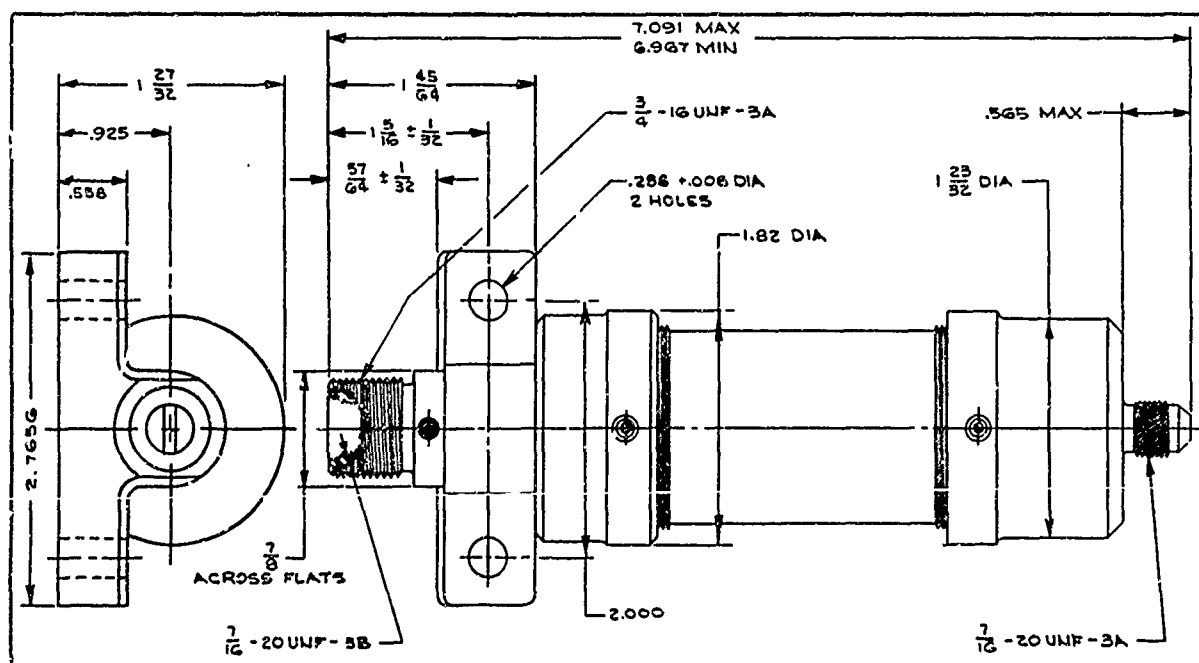
Propellant Actuated Devices

Initiator, Cartridge Actuated, M80



CROSS-SECTION DRAWING

Component	Component
A Cap, Shipping	F Cap
B Pin, Firing	G Cap, Shipping
C "O" Ring	H Filter
D Cap, Initiator	I "O" Ring
E Body	J Cartridge, Initiator, M69 Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M86

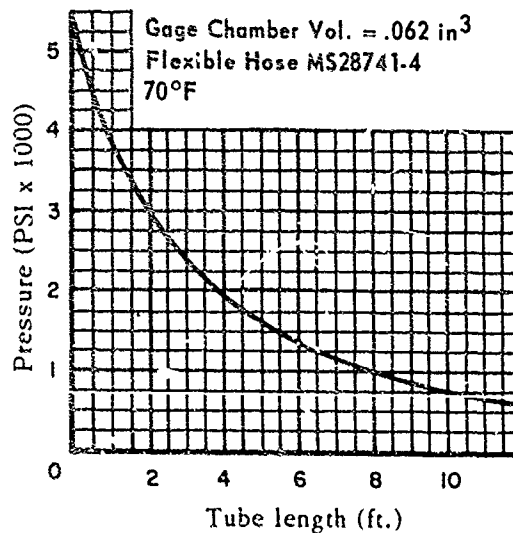
The M86 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M169 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge, flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

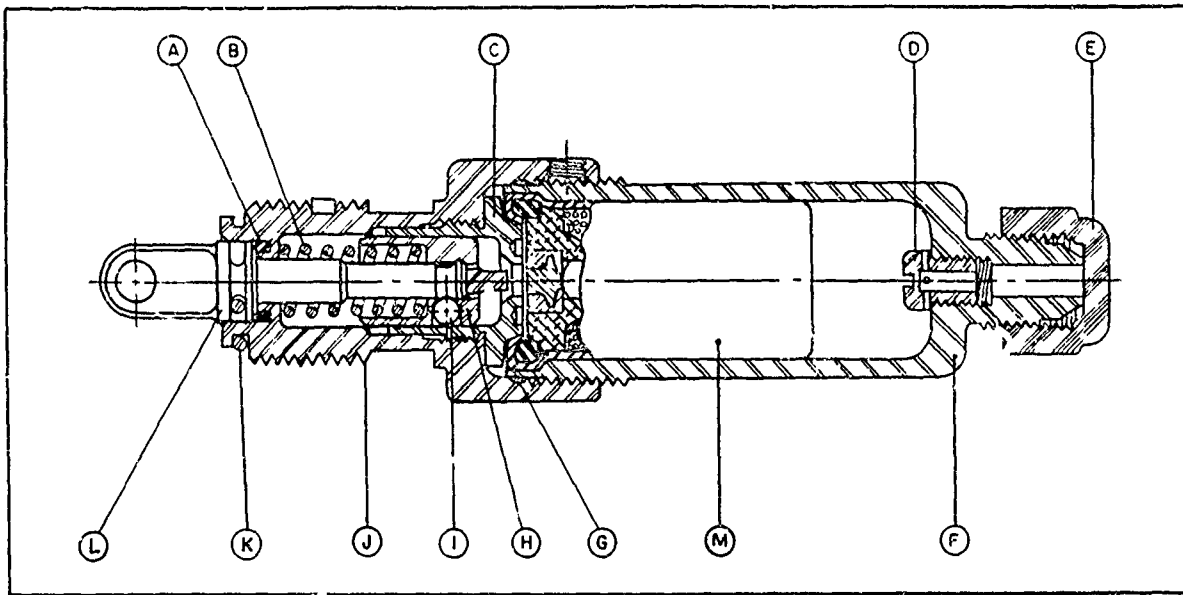
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.3 lb.
Mounting	Integral Thread

TYPICAL PERFORMANCE



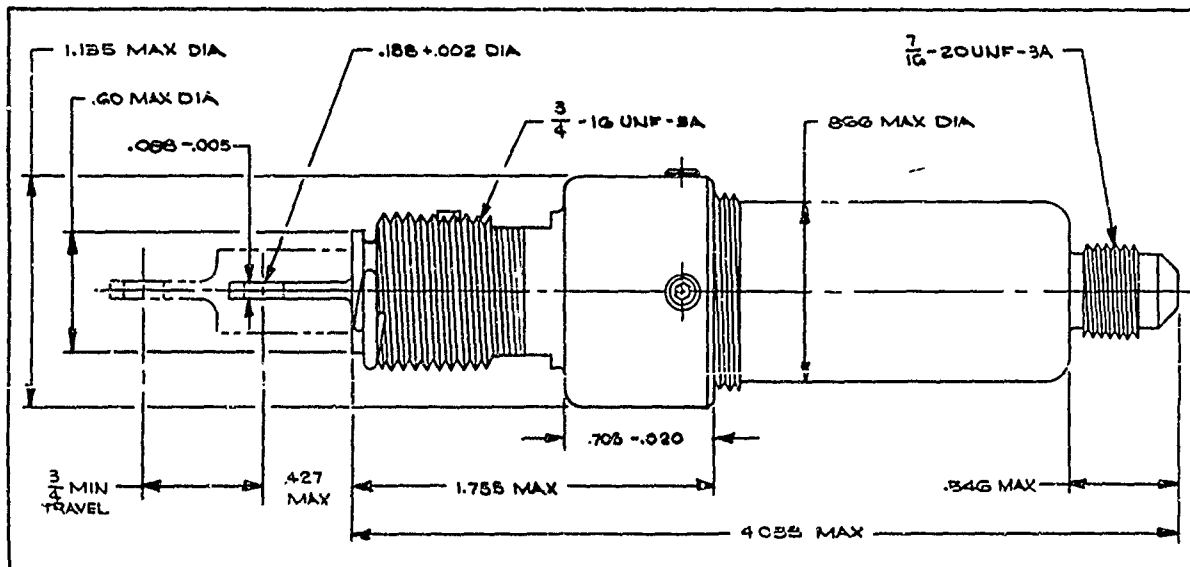
Propellant Actuated Devices

Initiator, Cartridge Actuated, M86



CROSS-SECTION DRAWING

Component	Component
A Seal	H Pin, Firing
B Spring, Initiator	I Ball
C Housing, Firing Pin	J Cap, Initiator
D Filter	K Pin, Safety
E Cap, Shipping	L Pin, Initiator
F Chamber, Initiator	M Cartridge, Impulse, M169
G "O" Ring	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M87

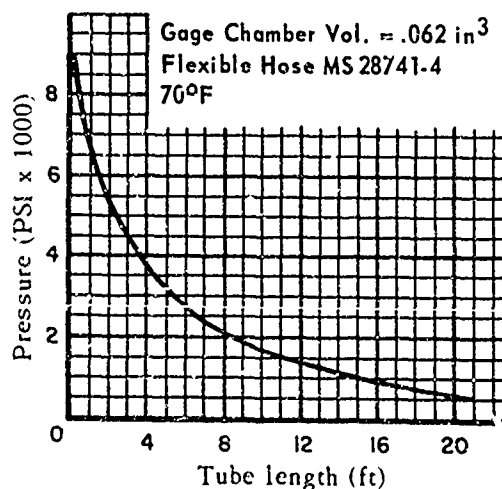
The M87 Initiator is a sealed M27 type Initiator which restricts toxic propellant gas leakage to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M173 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

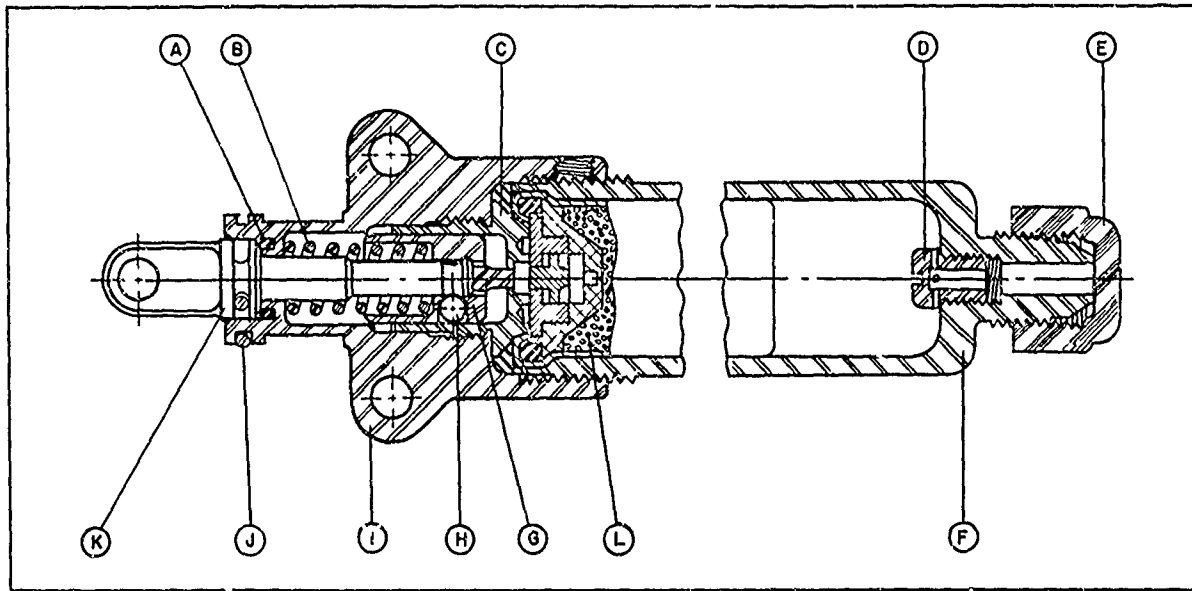
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature limits	-65°F to +160°F
Assembled Weight	0.33 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



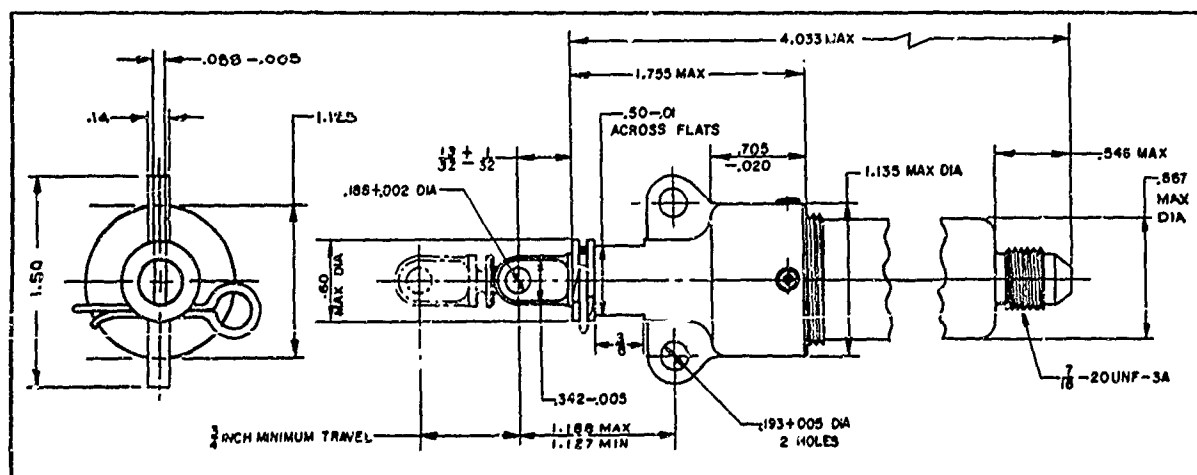
Propellant Actuated Devices

Initiator, Cartridge Actuated, M87



CROSS-SECTION DRAWING

Component	Component
A Seal	G Pin, Firing
B Spring, Initiator	H Ball
C Housing, Firing Pin	I Cap, Initiator
D Filter	J Pin, Safety
E Cap, Shipping	K Pin, Initiator
F Chamber, Initiator	L Cartridge, Impulse, M173



ENVELOPE DRAWING

INITIATOR, CARTRIDGE ACTUATED, DELAY, M88

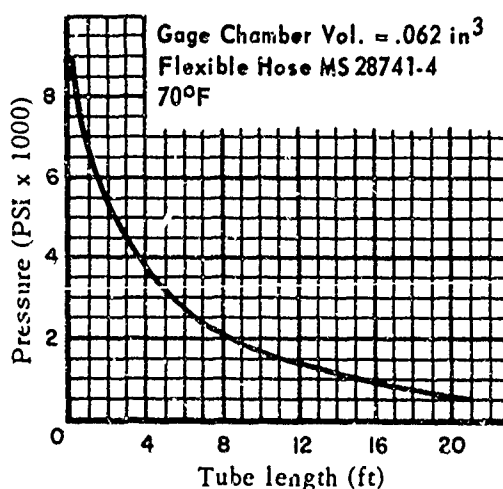
The M88 Initiator is a sealed M51 type Initiator which restricts toxic propellant gas leakage to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an M174 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM24 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

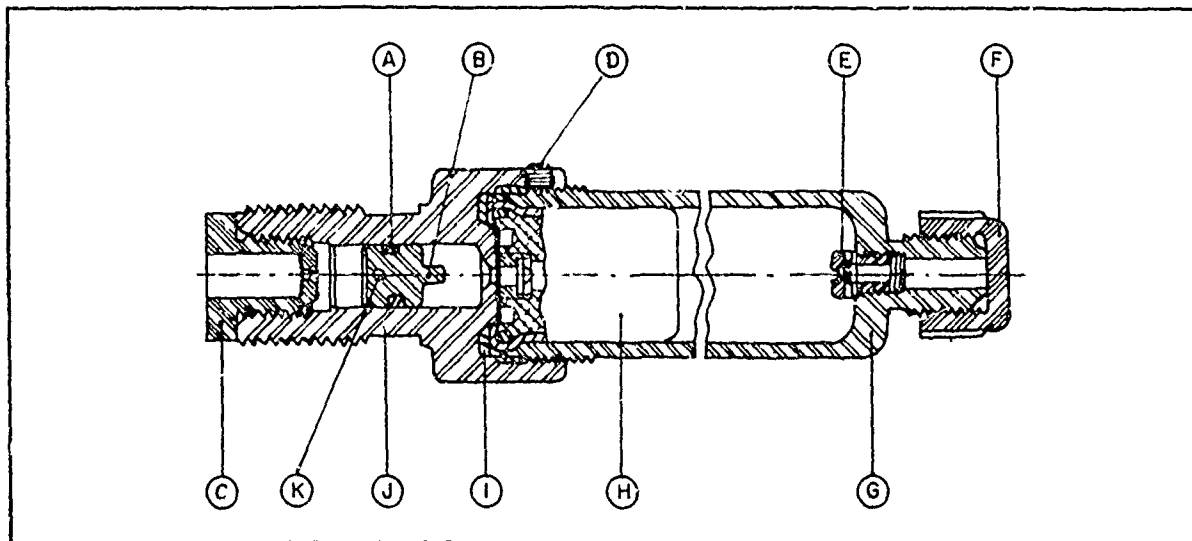
Actuation Method	Gas Pressure
Actuation Force	750 psi, min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lbs.
Delay Time	2.0 seconds
Mounting	Integral Threads

TYPICAL PERFORMANCE



Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M88



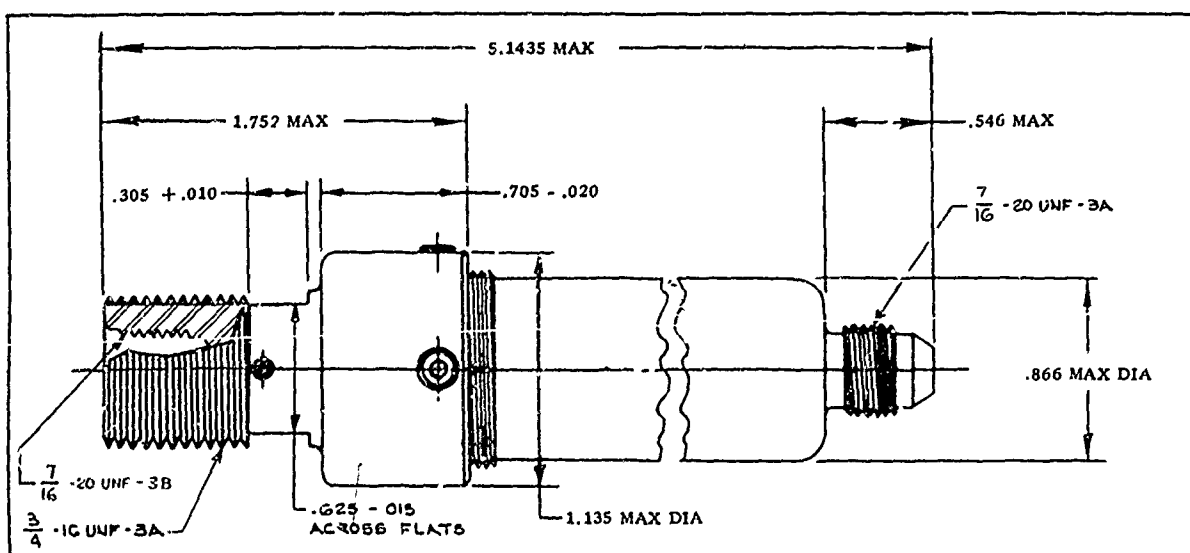
CROSS-SECTION DRAWING

Component

- A "O" Ring
- B Pin, Firing
- C Plug, Shipping
- D Screw, Set
- E Filter
- F Cap, Shipping

Component

- G Chamber, Initiator
- H Cartridge, Initiator, Delay, M174 Assembly
- I "O" Ring
- J Cap, Initiator
- K Pin, Shear



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, M89

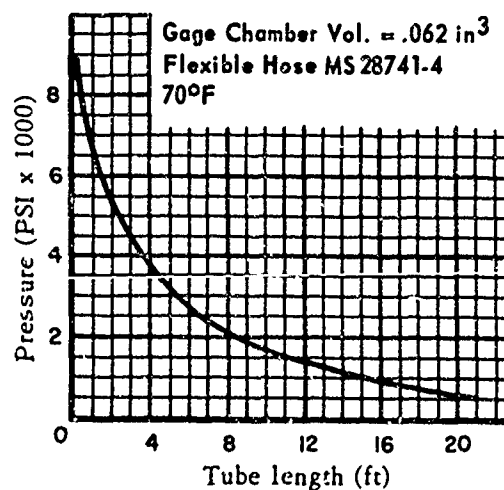
The M89 Initiator is a sealed M54 type Initiator which restricts toxic gas to prevent atmospheric contamination exceeding concentration limits safe for human occupancy in encapsulated environments. It consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M1.5 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an M27 Delay Element contained in the cartridge burns for 5 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

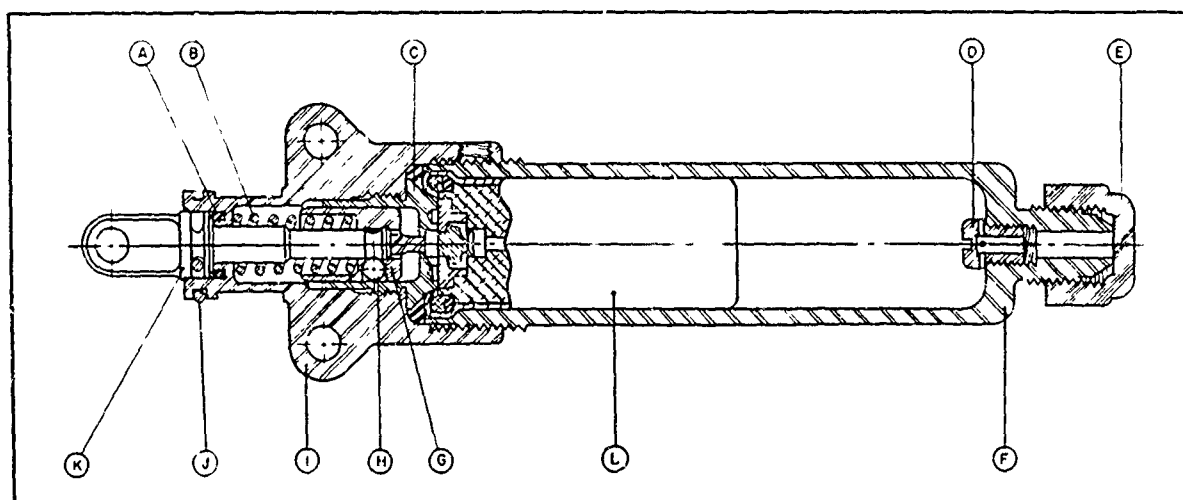
Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	5.0 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



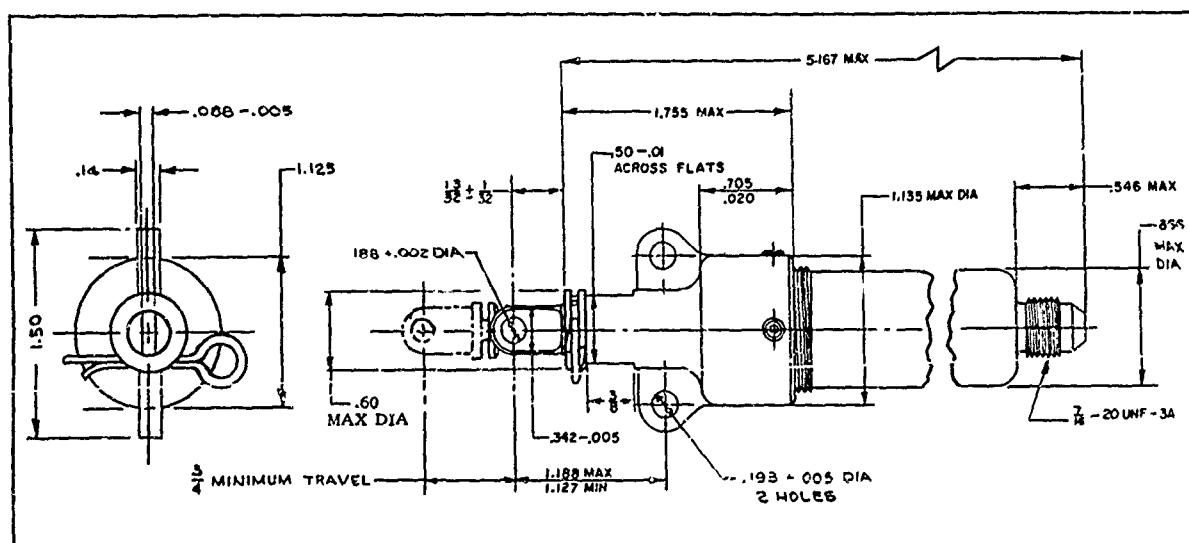
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, M89



CROSS-SECTION DRAWING

Component	Component
A Seal	H Ball
B Spring, Initiator	I Cap, Initiator
C Housing, Firing Pin	J Pin, Safety
D Filter	K Pin, Initiator
E Cap, Shipping	L Cartridge, Delay, M175 Assembly
F Chamber, Initiator	
G Pin, Firing	



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, M98

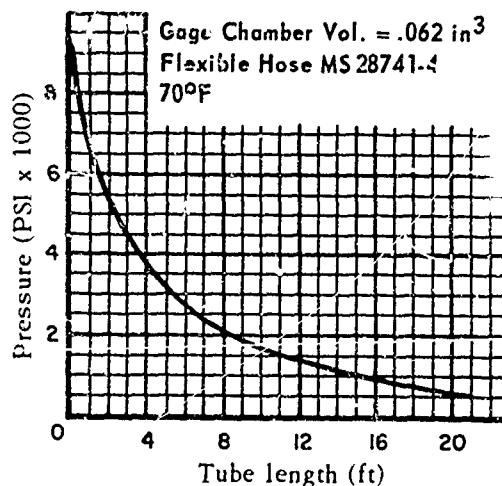
The M98 Initiator consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an XM201 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

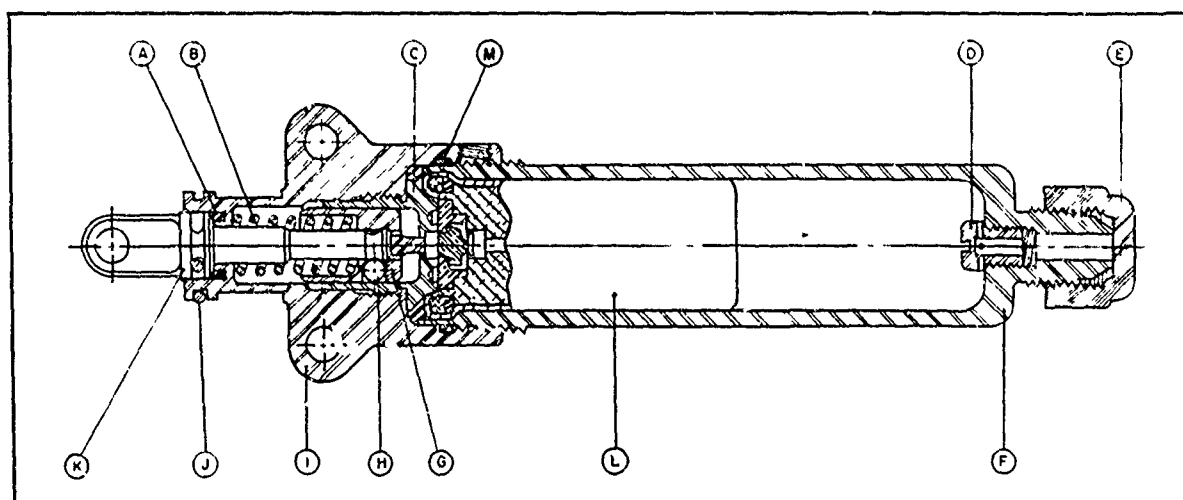
PRINCIPAL CHARACTERISTICS

Actuation Method	Mechanical
Actuation Force	40 lbs. min.
Temperature Limits	-65°F to +160°F
Assembled Weight	0.9 lb.
Mounting	Integral

TYPICAL PERFORMANCE

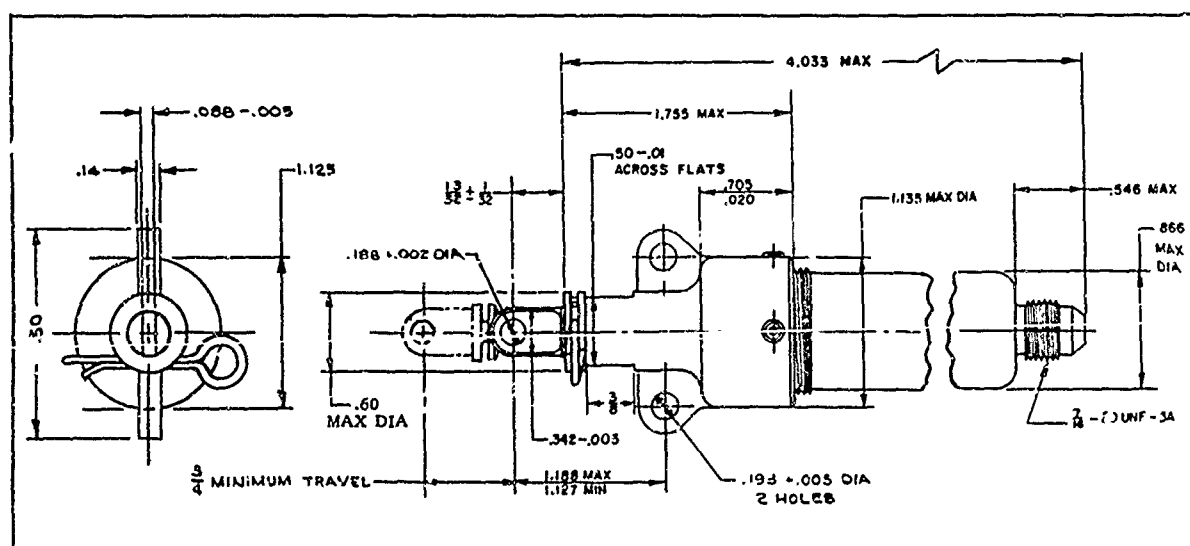


Initiator, Cartridge Actuated, M98



CROSS-SECTION DRAWING

<u>Component</u>	<u>Component</u>
A Seal	H Balls (3)
B Spring, Initiator	I Cap, Initiator
C Housing, Firing Pin	J Pin, Safety
D Filter	K Pin, Initiator
E Cap, Shipping	L Cartridge, Initiator,
F Chamber, Initiator	XM201 Assembly
G Pin, Firing	M "O" Ring



ENVELOPE DRAWING

Initiators

INITIATOR, CARTRIDGE ACTUATED, M99

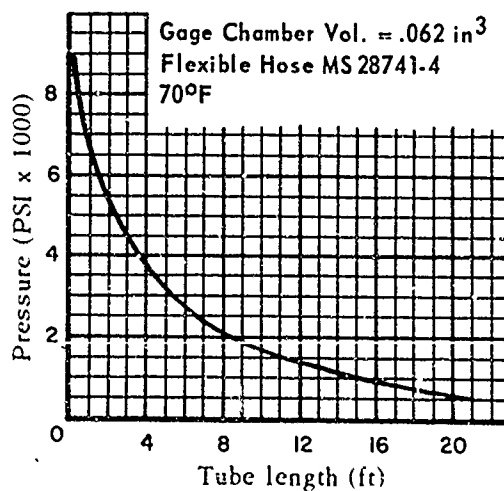
The M99 Initiator, a miniature version of the M3A2 Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M91 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

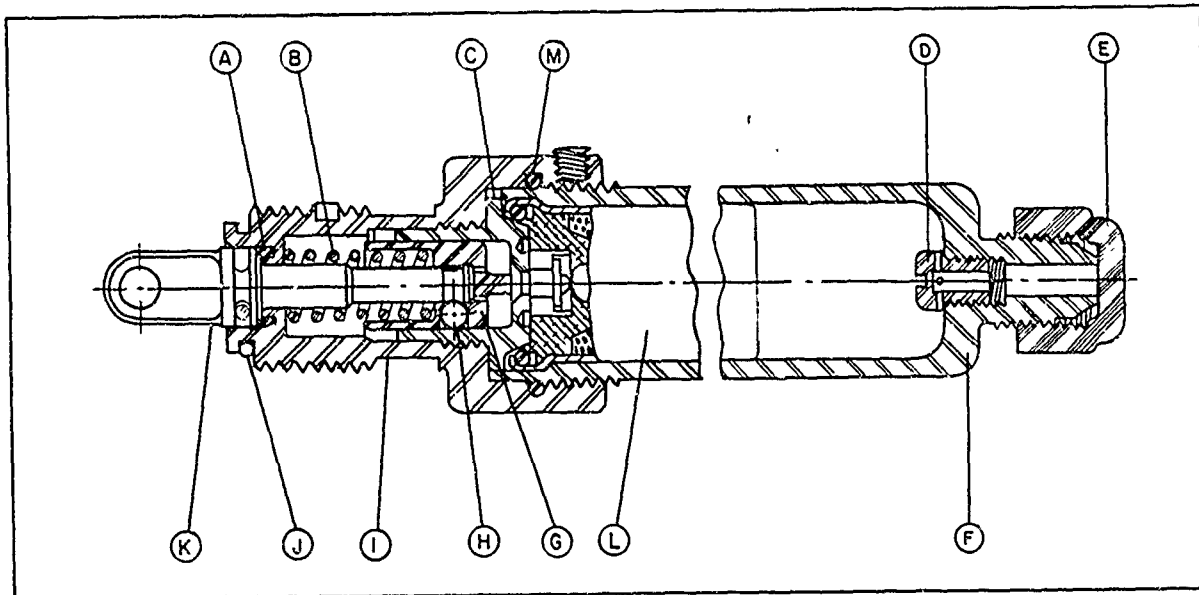
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65° to +160°F
Assembled Weight	0.33 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



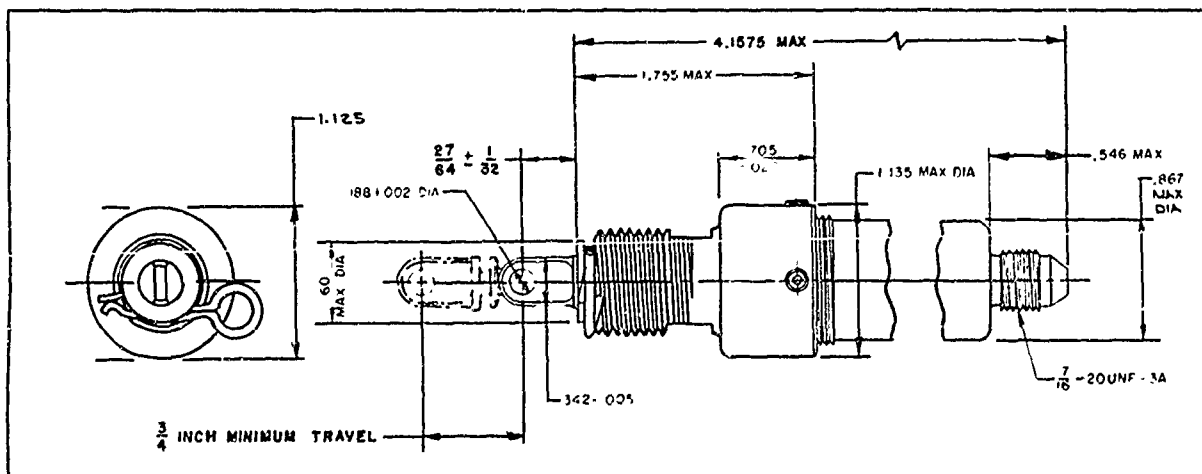
Propellant Actuated Devices

Initiator, Cartridge Actuated, M99



CROSS-SECTION DRAWING

Component	Component
A Seal	G Pin, Firing
B Spring, Initiator	H Balls (3)
C Housing, Firing Pin	I Cap, Initiator
D Filter	J Pin, Safety
E Cap, Shipping	K Pin, Initiator
F Chamber, Initiator	L Cartridge, Impulse
	M91 Assembly
	M "O" Ring



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, XM107

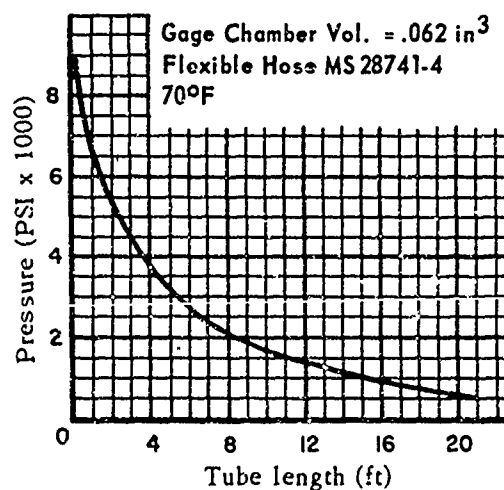
The XM107 Initiator, a miniature version of the M3A2 Initiator, consists of a constant volume chamber with a pressure outlet port incorporating a standard pressure fitting, a mechanically operated firing mechanism and an M91 Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, the gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or distance that the initiator can be mounted from the other device, is limited by the firing pin energy required for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

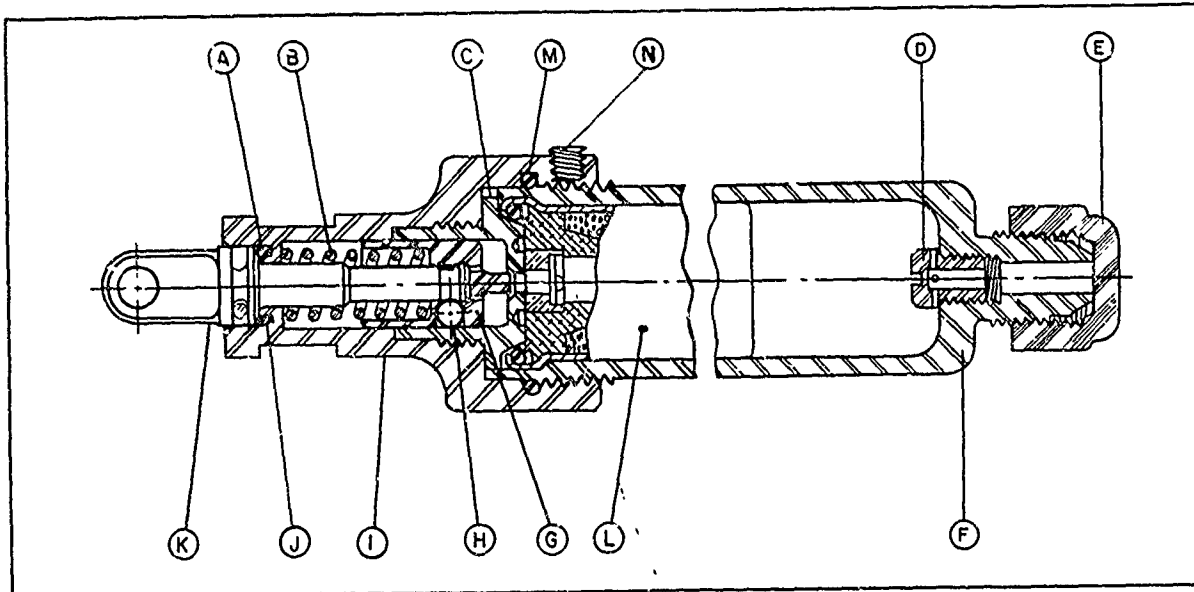
Actuation Method	Mechanical
Actuation Force	40 lbs min
Temperature Limits	-65° to +150°F
Assembled Weight	0.33 lb.
Mounting	Integral Lugs

TYPICAL PERFORMANCE



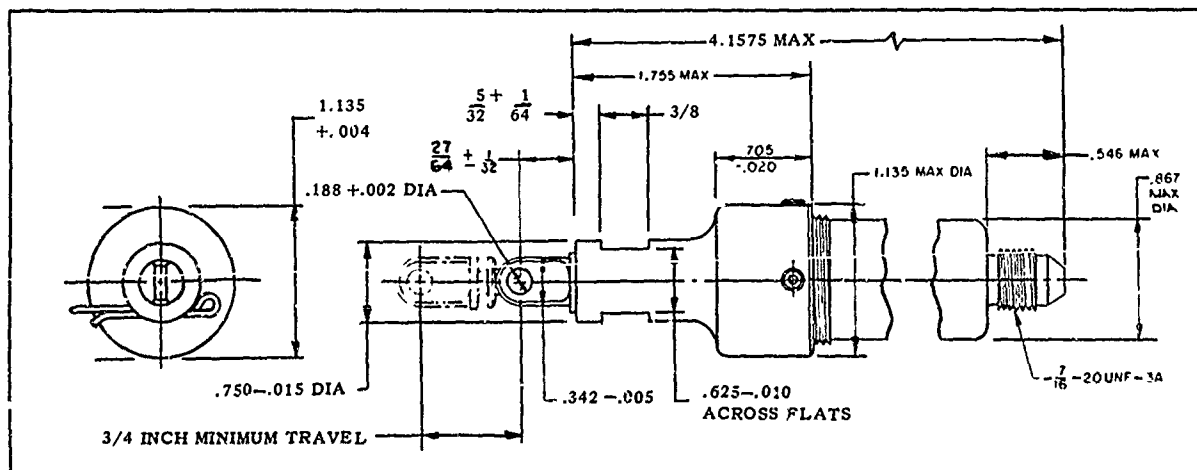
Propellant Actuated Devices

Initiator, Cartridge Actuated, Delay, XM107



CROSS-SECTION DRAWING

Component	Component
A Seal	G Pin, Firing
B Spring, Initiator	H Balls (3)
C Housing, Firing Pin	I Cap, Initiator
D Filter	J Pin, Cotter
E Cap, Shipping	K Pin, Initiator
F Chamber, Initiator	L Cartridge, Impulse, M91 Assy
	M "O" Ring
	N Set Screw



ENVELOPE DRAWING

Propellant Actuated Devices

Initiators

INITIATOR, CARTRIDGE ACTUATED, DELAY, XM110

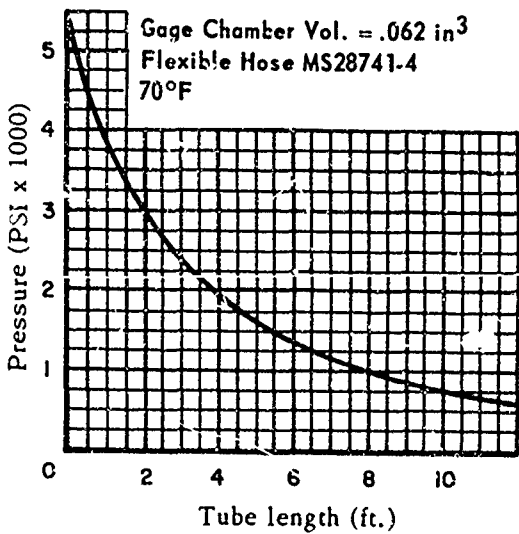
The XM110 Delay Initiator, a miniature version of the M44 Delay Initiator, consists of a constant volume chamber with a pressure outlet incorporating a standard pressure fitting, a gas pressure actuated firing mechanism and an XM271 Delay Cartridge. A length of tube or hose connects the initiator to another remotely installed propellant actuated device.

Upon cartridge function, an XM69 Delay Element contained in the cartridge burns for 1.4 seconds, after which the propellant and black powder are ignited. The gas produced by the burning of the propellant and black powder charge flows through the tube to the gas pressure actuated firing mechanism of the other propellant actuated device, exerting a force which propels the firing pin against the cartridge contained in that device. The length of the connecting tube and/or hose, or the distance that the initiator can be mounted from the other device is limited by the firing pin energy for reliable operation of the device.

PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Actuation Force	750 psi min
Temperature Limits	-65°F to +160°F
Assembled Weight	0.39 lb.
Delay Time	1.4 seconds
Mounting	Integral Lugs

TYPICAL PERFORMANCE



Initiator, Cartridge Actuated, Delay, XM110



Technical drawing of a mechanical part, showing front, top, and side views with dimensions and tolerances.

Front View (Left):

- Overall width: 1.50
- Overall height: 1.125
- Top flange thickness: .14
- Bottom flange thickness: .625
- Bottom flange material: ACROSS FLATE

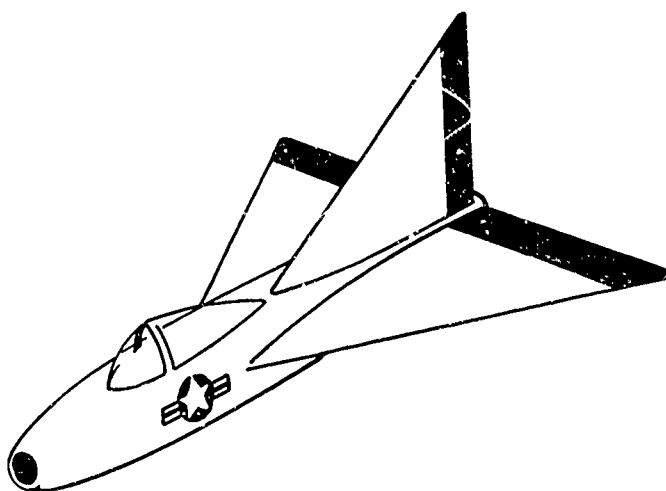
Top View (Right):

- Overall length: 5.1435 MAX
- Distance from left edge to center of first hole: 1.762 MAX
- Distance between centers of two holes: .705 ± .020
- Distance from center of second hole to right edge: .596 MAX
- Left hole diameter: .163 ± .005
- Right hole diameter: .186 DIA
- Thread specification for right hole: 7/16-20 UNF-3A
- Thread specification for left hole: 7/16-20 UNF-3B
- Distance from left edge to center of first hole: .7655 ± .0050
- Distance from center of first hole to center of second hole: .135 MAX DIA
- Distance from center of second hole to right edge: .866 DIA MAX

ENVELOPE DRAWING

Propellant Actuated Devices

Cutters



SECTION V

CUTTERS

INTRODUCTION

Description:

A cutter is a Propellant Actuated Device that is used in aerial delivery systems for cargo and drone recovery, or to sever wires or cables.

Cutters are classified in accordance with the following characteristics: (1) Method of Actuation – mechanical or gas pressure, and (2) Function Time – nondelay or delay.

Operation:

Actuation of the mechanical cutter is accomplished by applying a pull force to the cable or lanyard with seat attached. The lanyard seat is engaged in the firing pin; therefore, the pull of the lanyard applies a load to the firing pin spring. Compression of the firing pin spring and the release of the firing pin are accomplished with one motion when the firing pin moves rearward. The sear moves outward to the section having an enlarged internal diameter, which then permits the sear to move sideward to release the firing pin. The firing pin is propelled forward under the actuation of a spring force and strikes the primer, which ignites the delay element, if applicable, and then the propellant. Under the force of the propellant gas pressure, the cutter blade separates from the cartridge case and is propelled into the bore of the housing. The wires or cables are severed when the blade impacts the anvil.

Cutter

CUTTER M8

The M8 Cable Cutter is a component part of an aircraft escape system whose purpose is to sever wires or cables prior to implementing the escape procedure of aircraft personnel from the aircraft. The cutter is capable of severing either a bundle of coaxial cables or a bundle of wires. The blade of the cutter is coated to prevent shorting as the blade passes through the cables or wires.

The cutter is cylindrical in shape, approximately 5.8 inches long and .3 inches in diameter. The blade of the cutter is held in position by a "shear pin" which will shear in double shear when a load of 2160[±]200 pounds is applied.

The cutter incorporates a propellant gas operated firing mechanism. It is actuated by gas pressure supplied from another propellant actuated device.

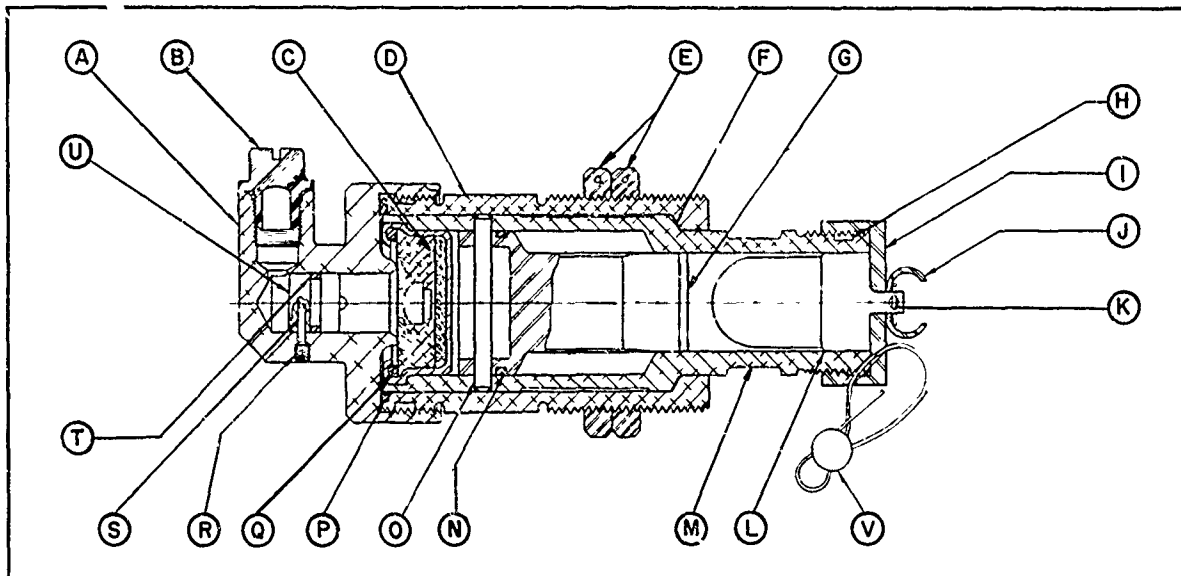
PRINCIPAL CHARACTERISTICS

Stroke	1.25 inches
Assembled Weight	.75 lbs.
*Blades average depth of penetration into anvil when fired at 70°F	.004 inches
Firing Method	Propellant Gas
Temperature Limits	-65°F to +200°F
Material Severed	
Cable Assembly	.060 inch thick vinyl sheath around 9 RG-62 A/U Coax Cables (MIL-C-17/30)
Wire Bundle	.060 inch thick vinyl sheath around 27 strands #22 wire (MIL-W-8777) 6 strands #18 wire (MIL-W-8777) 8 strands #20 wire (MIL-W-12349)

* Depth of penetration of the blade into the anvil is a rough measure of the kinetic energy remaining in the blade after it has cut the cable. It is also an indication of the margin of safety insuring that the cable will be severed.

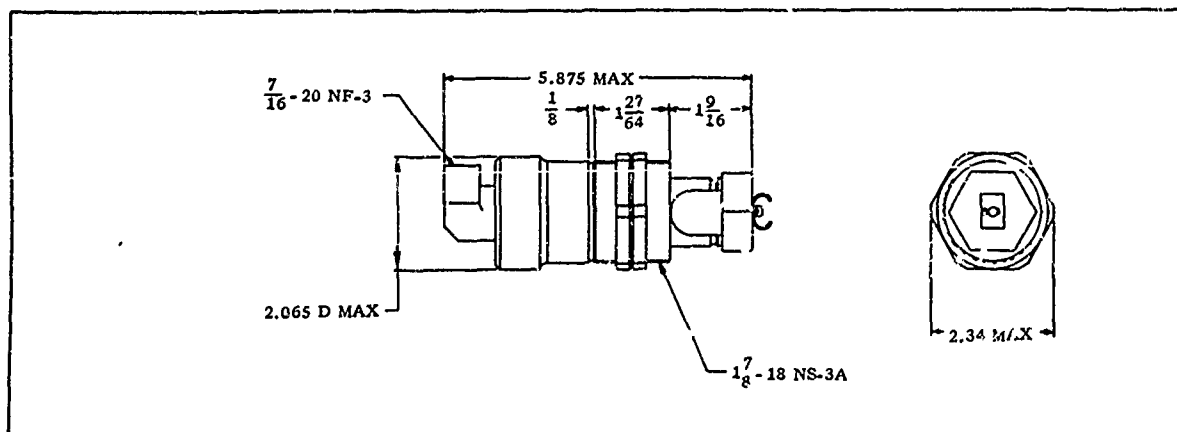
Propellant Actuated Devices

Cutter, Cartridge Actuated, M8



CROSS-SECTION DRAWING

Component	Component
A Head	L Anvil
B Plug, Shipping	M Swivel Assembly
C Cartridge, Cutter M122	N "O" Ring
D Body Assembly	O Pin, Shear Unlock
E Nut, Mounting	P "O" Ring
F Gasket	Q "O" Ring
G Blade	R Screw, Set
H Pellet (Shown 22° 30' out of Position)	S Pin, Shear
I Cap	T "O" Ring
J Clip, Cable Holder	U Pin, Firing
K Pin, Cotter	V Seal, Car



ENVELOPE DRAWING

Propellant Actuated Devices

Cutters

CUTTER, M9

The M9 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of an M129 Delay Cartridge which is fired mechanically by applying a force to a cable or lanyard.

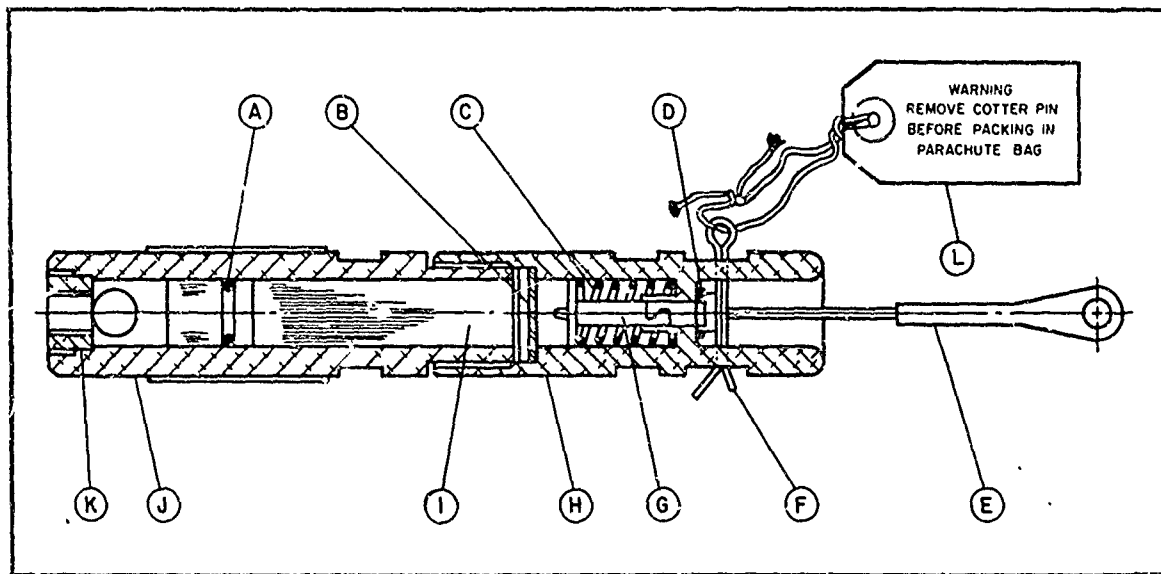
Upon actuation of the device, an XM29 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly Weight	4.0 Ounces
Temperature limits	-95° F to +250° F
Firing Method	Mechanical lanyard
Shock	750g
Acceleration	400g
Material Severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	2 Seconds

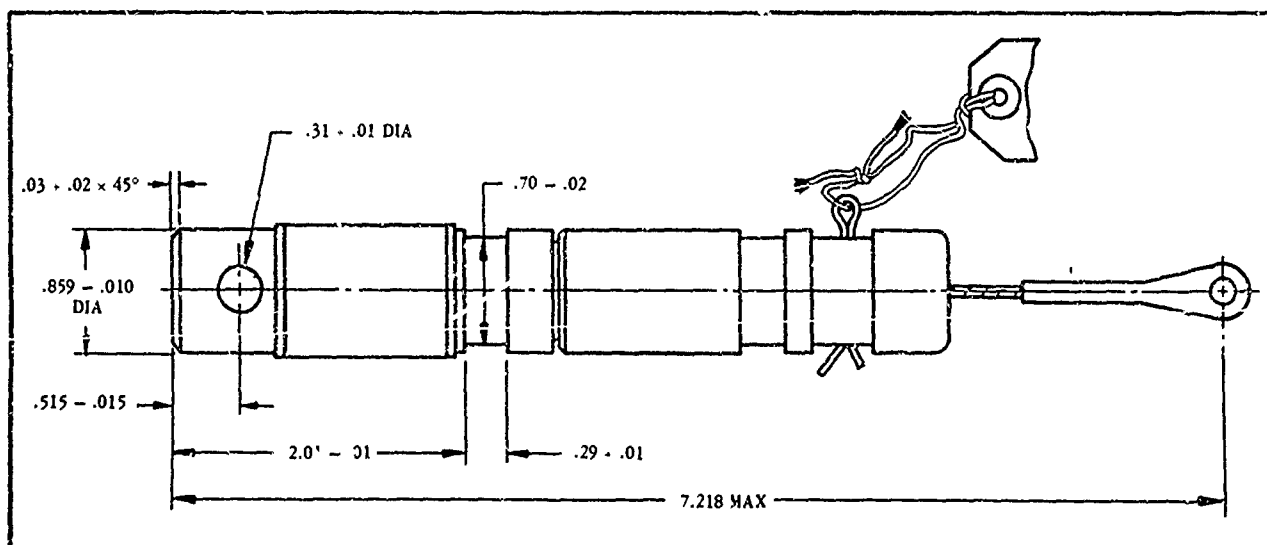
Propellant Actuated Devices

Cutter, Powder Actuated, M9



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Pin, Firing
B Washer	H Firing Head Assembly
C Spring	I Cartridge, Delay, M129, Assembly
D Seal	J Housing
E Initiator	K Anvil
F Fin, Cotter	L Tag, Warning



ENVELOPE DRAWING

Propellant Actuated Devices

Cutters

CUTTER, XM10

The XM10 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of an XM130 Delay Cartridge which is fired mechanically by applying a force to a cable or lanyard.

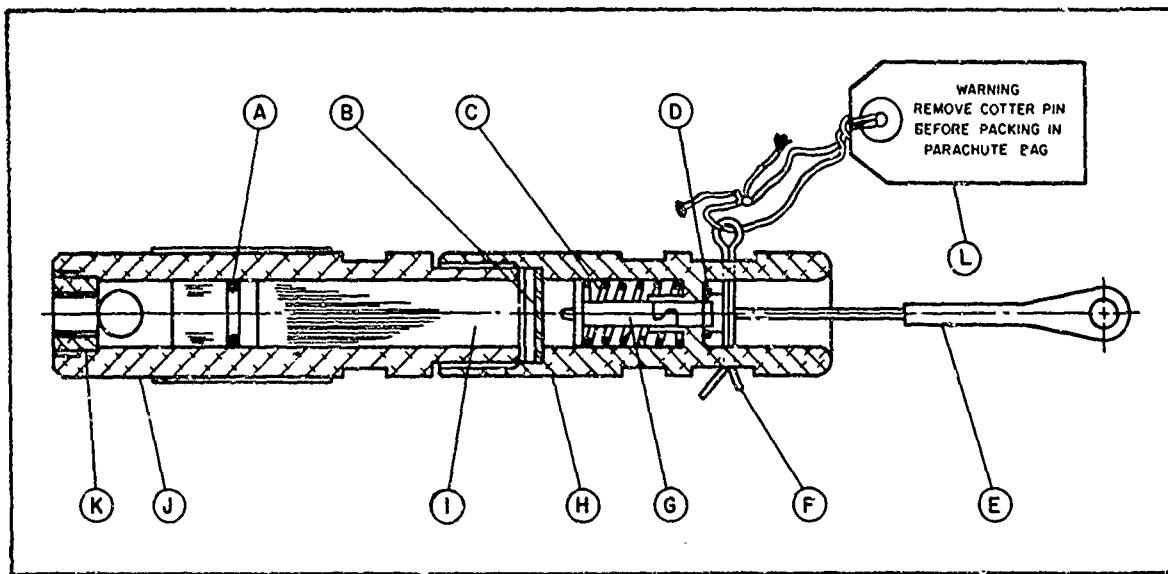
Upon actuation of the device, an XM30 Delay Element contained in the cartridge burns for 4 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly Weight	4.0 Ounces
Temperature limits	-95° F to +250° F
Firing Method	Mechanical lanyard
Shock	750g
Acceleration	400g
Material Severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	4 Seconds

Propellant Actuated Devices

Cutter, Powder Actuated, XM10



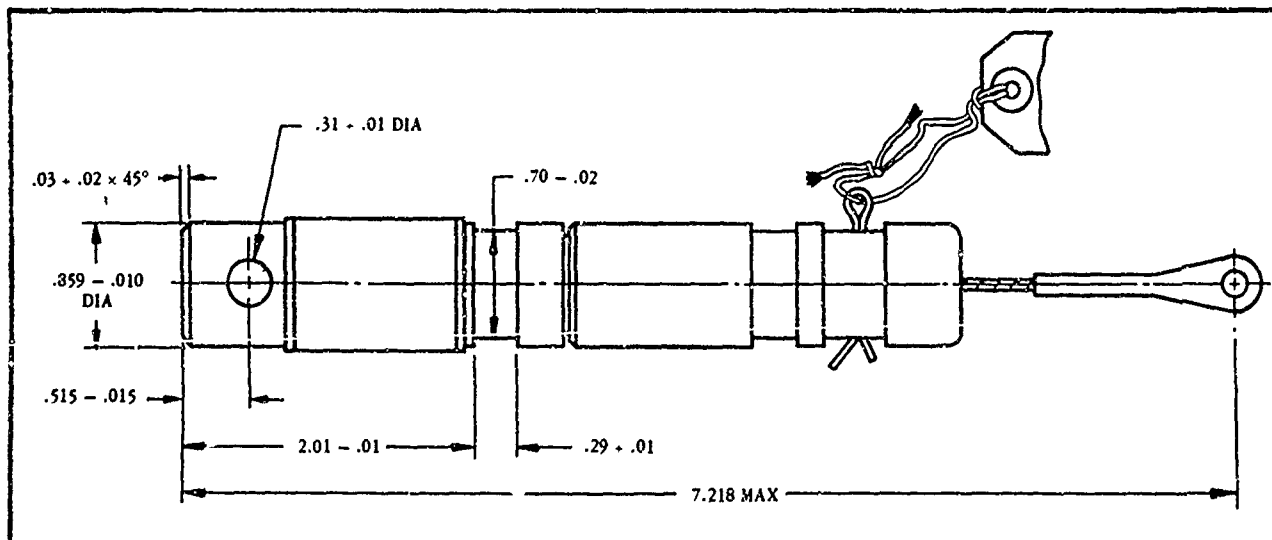
CROSS-SECTION DRAWING

Component

- A "O" Ring
- B Washer
- C Spring
- D Seal
- E Initiator
- F Pin, Cotter

Component

- G Pin, Firing
- H Firing Head Assembly
- I Cartridge, Delay, XM130 Assembly
- J Housing
- K Anvil
- L Tag, Warning



ENVELOPE DRAWING

Propellant Actuated Devices

Cutters

CUTTER, XM11

The XM11 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of an XM131 Delay Cartridge which is fired mechanically by applying a force to a cable or lanyard.

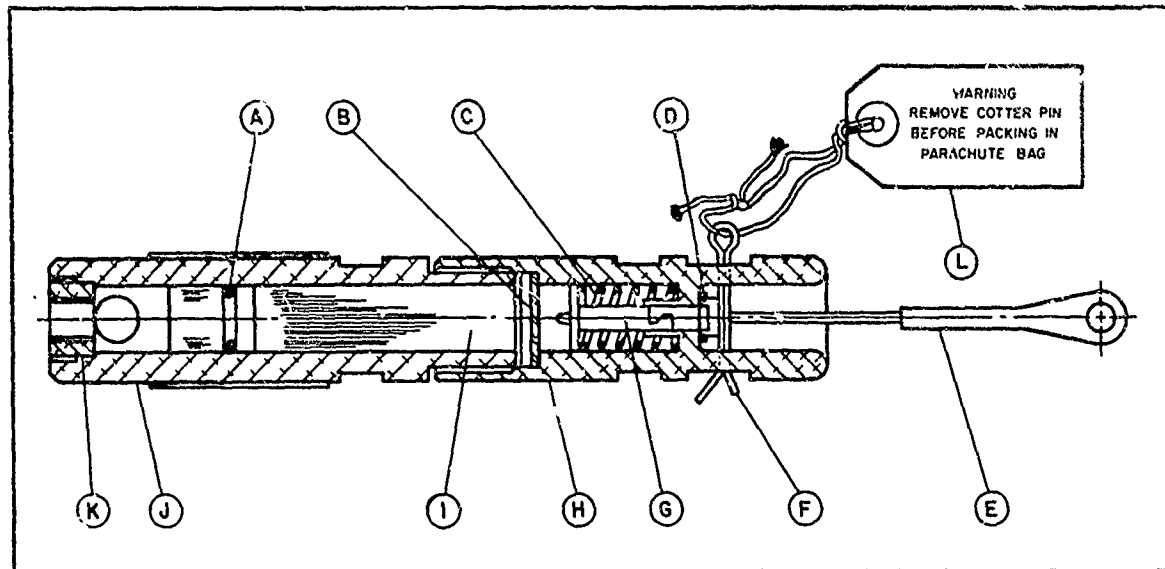
Upon actuation of the device, an XM31 Delay Element contained in the cartridge burns for 6 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly Weight	4.0 Ounces
Temperature limits	-95° F to 250° F
Firing Method	Mechanical lanyard
Shock	750g
Acceleration	400g
Material Severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	6 Seconds

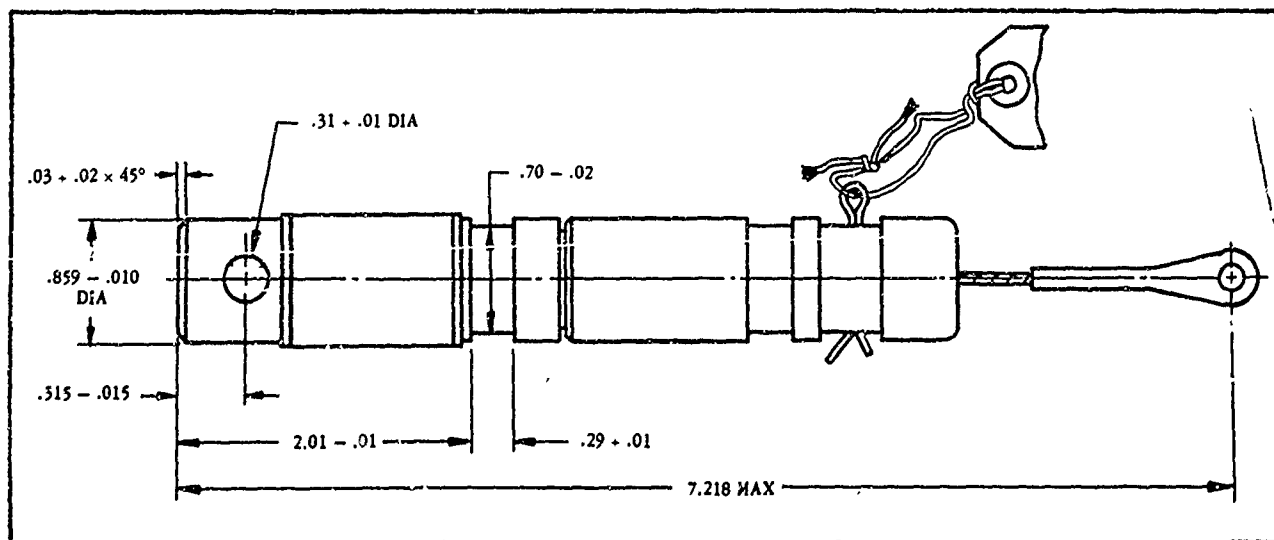
Propellant Actuated Devices

Cutter, Powder Actuated, XM11



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Pin, Firing
B Washer	H Firing, Head Assembly
C Spring	I Cartridge, Delay, XM131, Assembly
D Seal	J Housing
E Initiator	K Anvil
F Pin, Cotter	L Tag, Warnin g



ENVELOPE DRAWING

Cutters

CUTTER, XM12

The XM12 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of an XM132 Delay Cartridge which is fired mechanically by applying a force to a cable or lanyard.

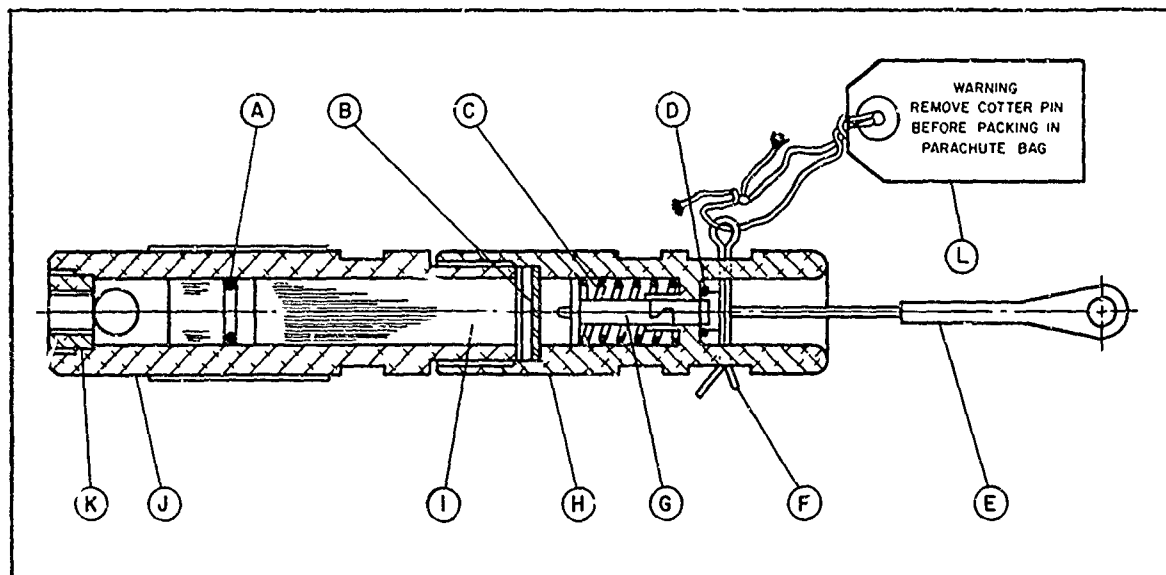
Upon actuation of the device, an XM32 Delay Element contained in the cartridge burns for 8 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly Weight	4.0 Ounces
Temperature limits	-95° F to +250° F
Firing Method	Mechanical lanyard
Shock	750g
Acceleration	400g
Material Severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	8 Seconds

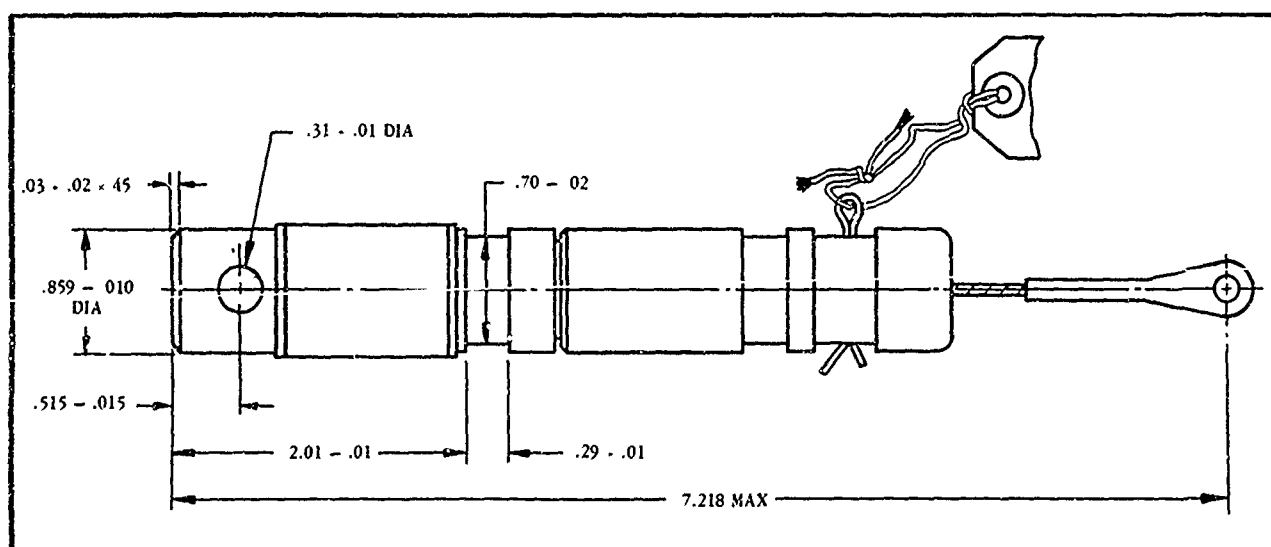
Propellant Actuated Devices

Cutter, Powder Actuated, XM12



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Pin, Firing
B Washer	H Firing Head Assembly
C Spring	I Cartridge, Delay, XM132, Assembly
D Seal	J Housing
E Initiator	K Anvil
F Pin, Cotter	L Tag, Warning



ENVELOPE DRAWING

Propellant Actuated Devices

Cutters

CUTTER, M13

The M13 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of an M133 Delay Cartridge which is fired mechanically by applying a force to a cable or lanyard.

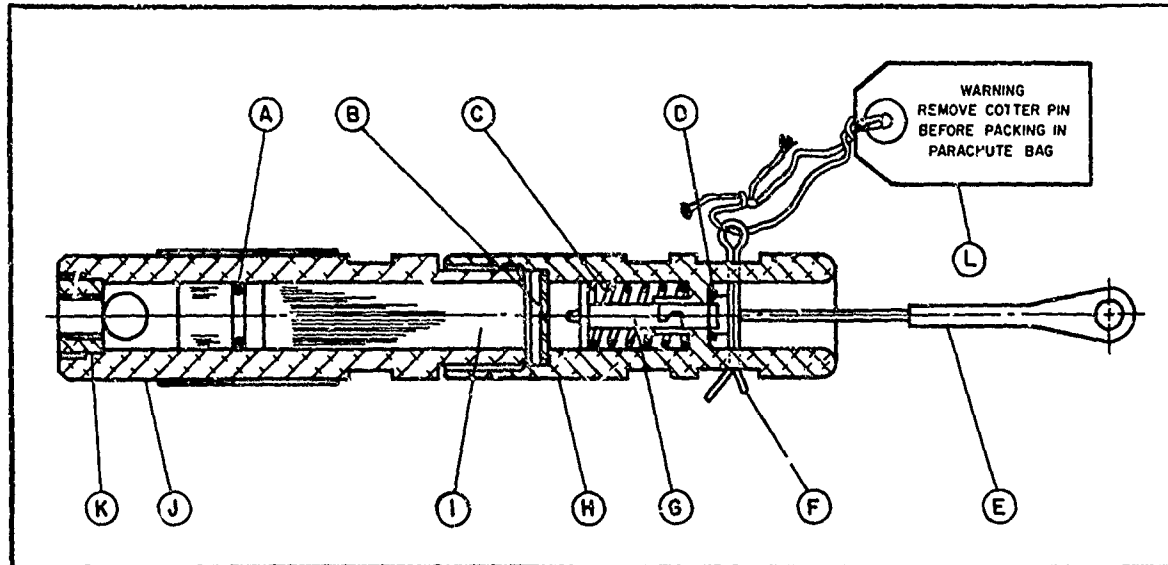
Upon actuation of the device, an XM33 Delay Element contained in the cartridge burns for 10 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly Weight	4.0 Ounces
Temperature limits	-95° F to +250° F
Firing Method	Mechanical lanyard
Shock	750g
Acceleration	400g
Material Severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	10 Seconds

Propellant Actuated Devices

Cutter, Powder Actuated, M13



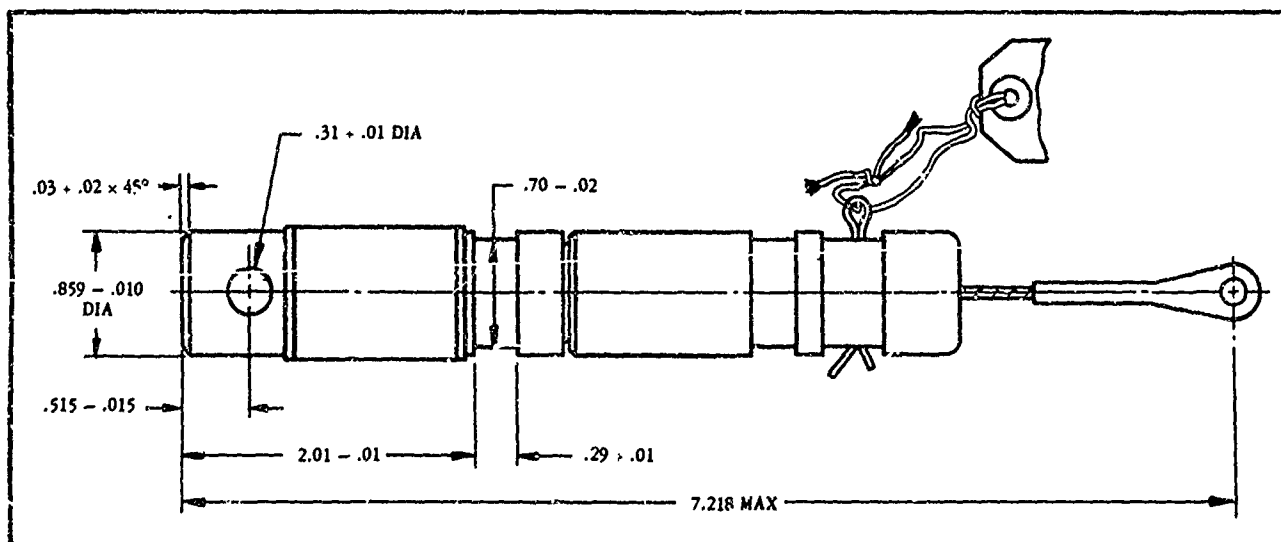
CROSS-SECTION DRAWING

Component

- A "O" Ring
- B Washer
- C Spring
- D Seal
- E Initiator
- F Pin, Cotter

Component

- G Pin, Firing
- H Firing Head Assembly
- I Cartridge, Delay, M133, Assembly
- J Housing
- K Anvil
- L Tag, Warning



ENVELOPE DRAWING

Propellant Actuated Devices

Cutters

CUTTER, M21

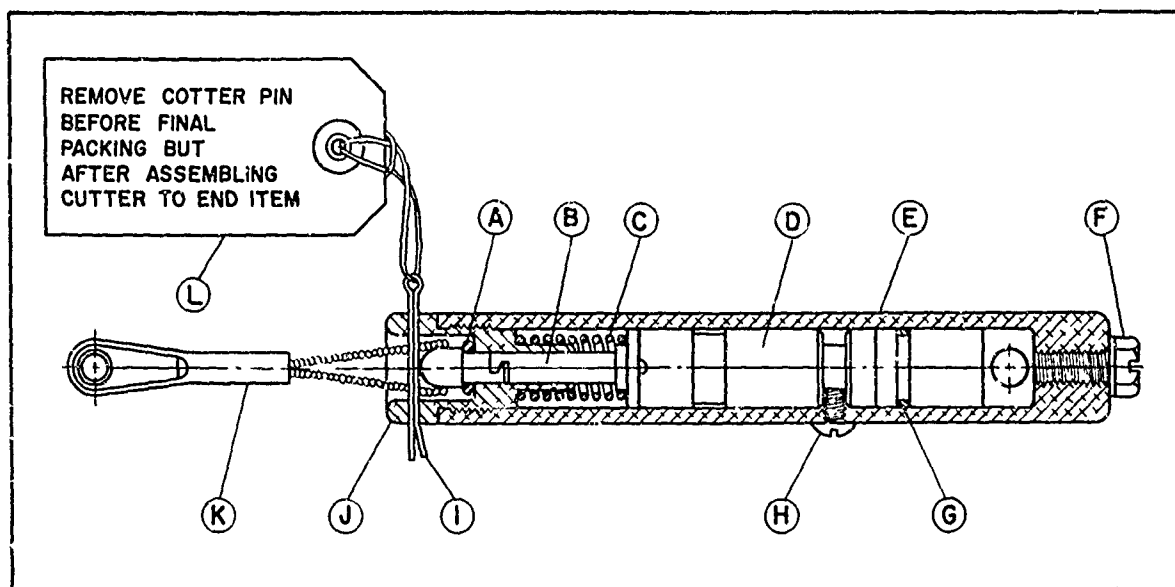
The M21 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of a delay cartridge which is fired mechanically by applying a force to a lanyard. Upon actuation of the device, a delay element contained in the cartridge burns for 2 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly weight	4.5 ounces
Temperature limits	-65°F to +160°F
Firing Method	Mechanical lanyard
Shock	750 g
Material severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	2 Seconds

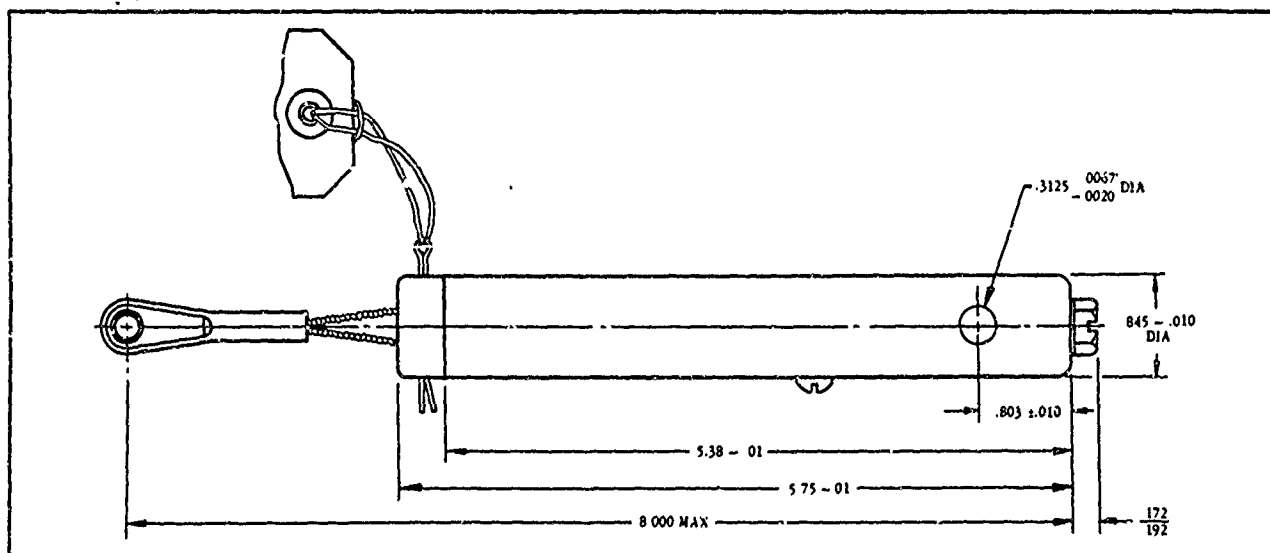
Propellant Actuated Devices

Cutter, Powder Actuated, M21



CROSS-SECTION DRAWING

Component	Component:
A "O" Ring	G Gasket "O" Ring
B Pin, Firing	H Screw, Machine, Slotted, Round Head
C Spring	I Pin, Cotter
D Knife Delay Assembly	J Retainer
E Case	K Lanyard Assembly
F Screw, Machine, Slotted, Hex Head	L Tag, Warning



ENVELOPE DRAWING

Propellant Actuated Devices

Cutters

CUTTER, M22

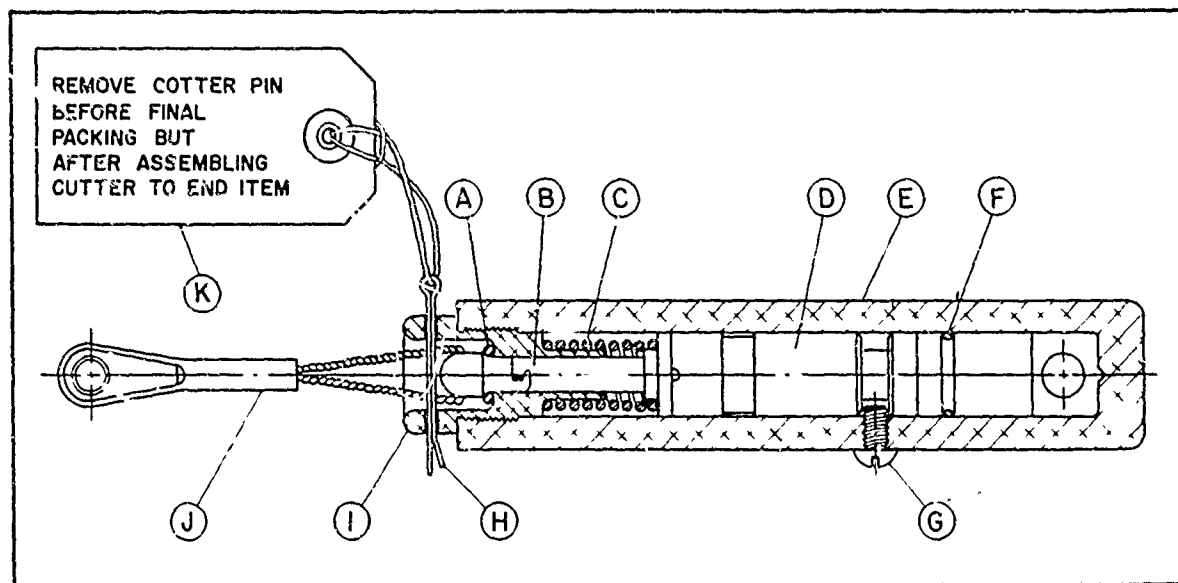
The M22 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of a delay cartridge which is fired mechanically by applying a force to a lanyard. Upon actuation of the device, a delay element contained in the cartridge burns for 10 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly weight	4.5 ounces
Temperature limits	-65°F to +160°F
Firing Method	Mechanical lanyard
Shock	750 g
Material severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	10 seconds

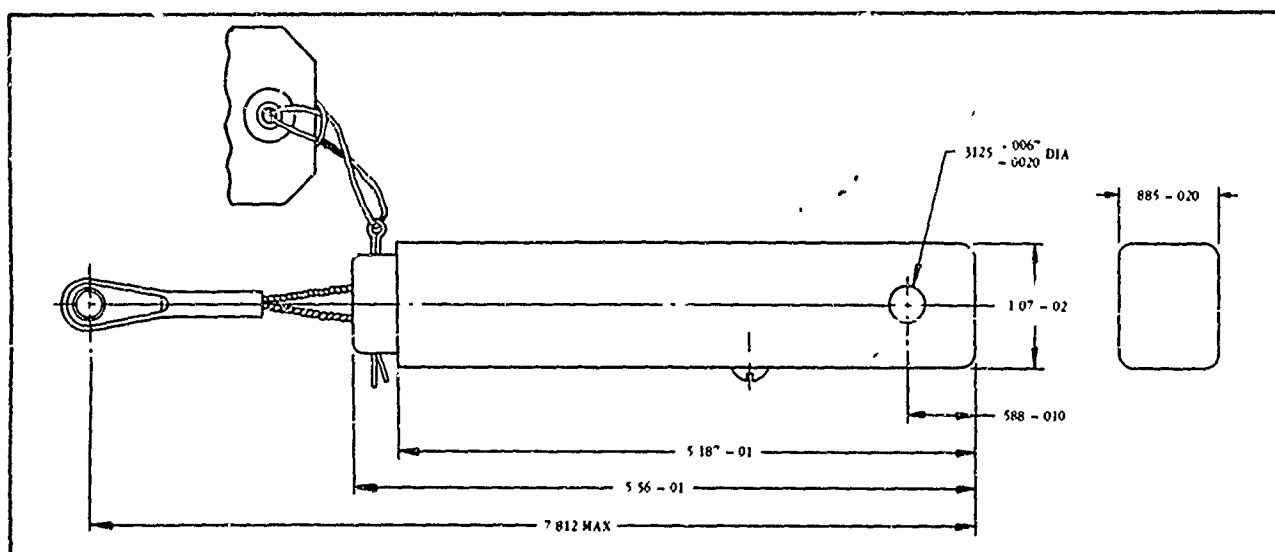
Propellant Actuated Devices

Cutter, Powder Actuated, M22



CROSS-SECTION DRAWING

Component	Component
A "O" Ring	G Screw, Machine, Slotted, Round Head
B Pin, Firing	H Pin, Cotter
C Spring	I Retainer
D Knife Delay Assembly	J Lanyard Assembly
E Case	K Tag, Warning
F Gasket "O" Ring	



ENVELOPE DRAWING

Propellant Actuated Devices

Cutters

CUTTER, XM23

The XM23 Cutter is a component part of an aerial delivery system for cargo and drone recovery. Its purpose is to sever cords or wires. It consists of an M129 Delay Cartridge which is fired mechanically by applying a force to a cable or lanyard.

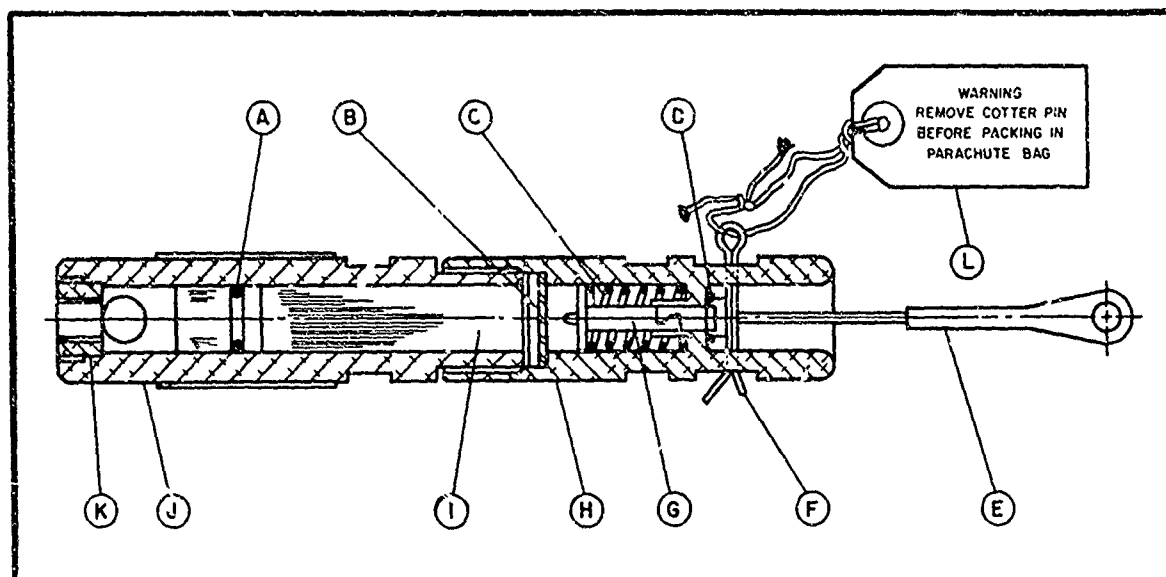
Upon actuation of the device, an XM29 Delay Element contained in the cartridge burns for 2 seconds, after which the propellant is ignited. The gas produced by the burning of the propellant exerts a force on the cutter blade. The cutter blade separates from the case and is propelled in the bore of the housing which contains the cords or wires to be severed. The cords or wires are severed when the blade impacts upon the anvil.

PRINCIPAL CHARACTERISTICS

Assembly Weight	4.0 Ounces
Temperature limits	-65° F to +160° F
Firing Method	Mechanical lanyard
Shock	750g
Acceleration	400g
Material Severed	Two 1/2-inch 1000 lb tubular nylon lines
Delay Time	2 Seconds

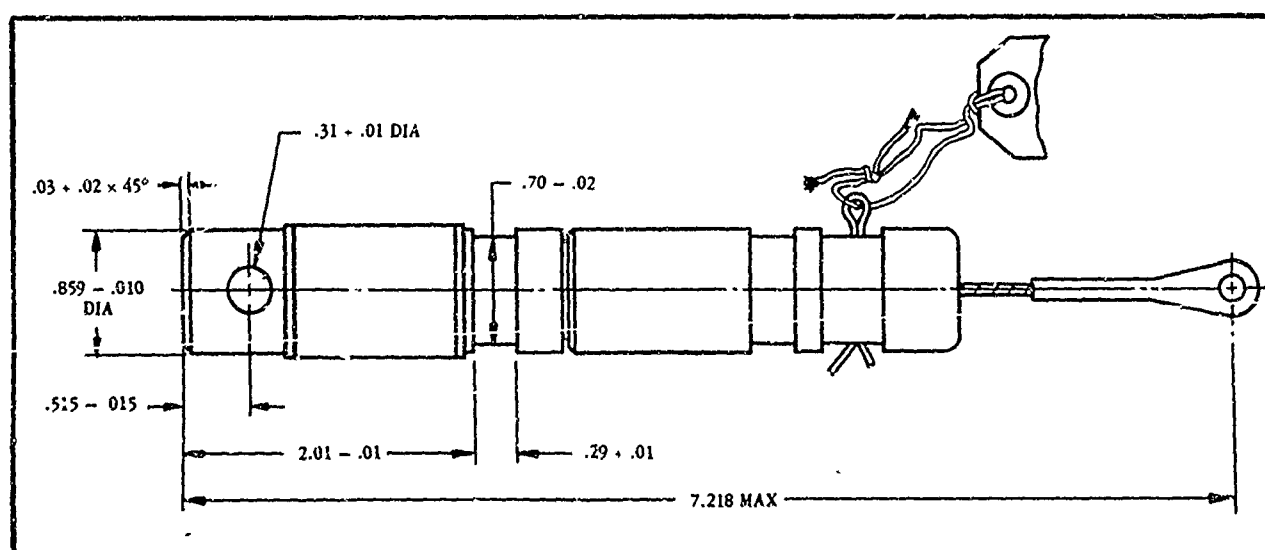
Propellant Actuated Devices

Cutter, Powder Actuated, XM23



CROSS-SECTION DRAWING

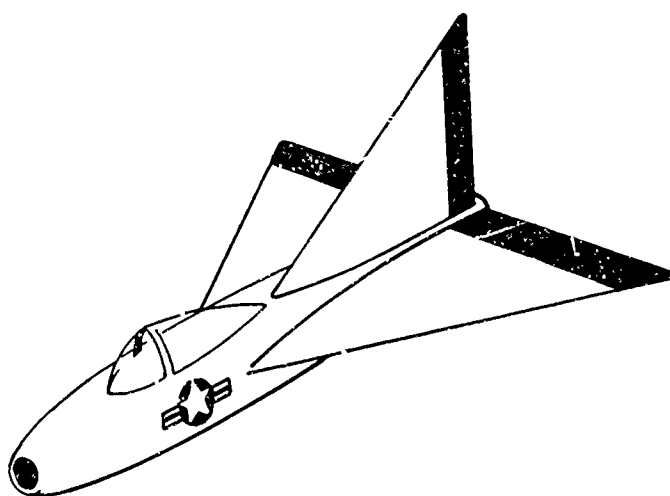
Component	Component
A "O" Ring	G Pin, Firing
B Washer	H Firing Head Assembly
C Spring	I Cartridge, Delay, M129, Assembly
D Seal	J Housing
E Initiator	K Anvil
F Pin, Cotter	L Tag, Warning



ENVELOPE DRAWING

Propellant Actuated Devices \

Miscellaneous



SECTION VI

MISCELLANEOUS

Propellant Actuated Devices

Accessory For Pad

RELEASE, FIRING PIN, M1A1

The M1A1 Firing Pin Release is a gas pressure actuated device which performs firing pin release function for such devices as the M1A3 Remover. It is a piston and cylinder unit, actuated by propellant gas pressure supplied from another propellant actuated device. As gas pressure is introduced through the intake port, a force is exerted on the unlocking piston resulting in its displacement and the release of the rod and piston assembly. Upon release, the rod and piston assembly is propelled by gas pressure through the cylinder causing withdrawal of the extended rod into the unit.

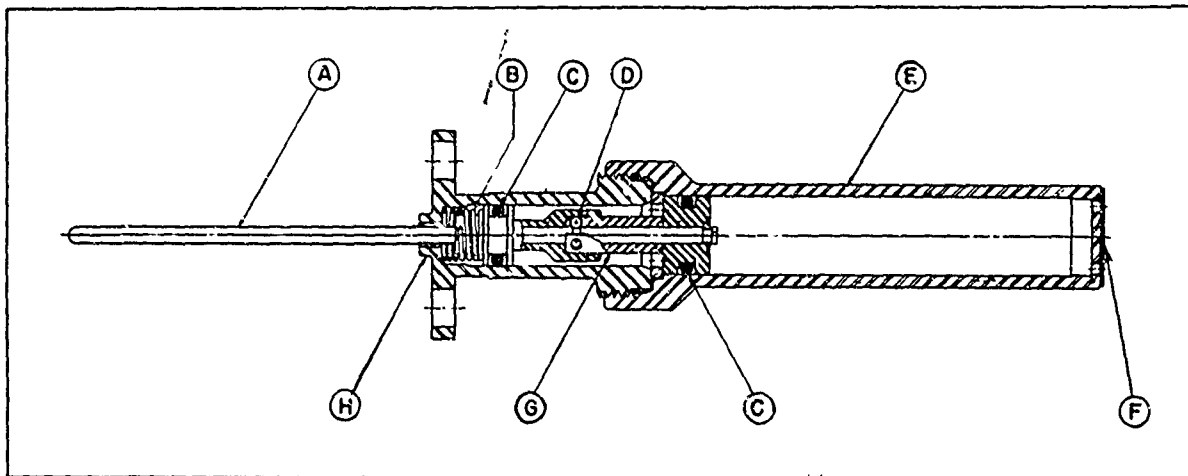
PRINCIPAL CHARACTERISTICS

Actuation Method
Actuation Force

Gas Pressure
250 psi min.

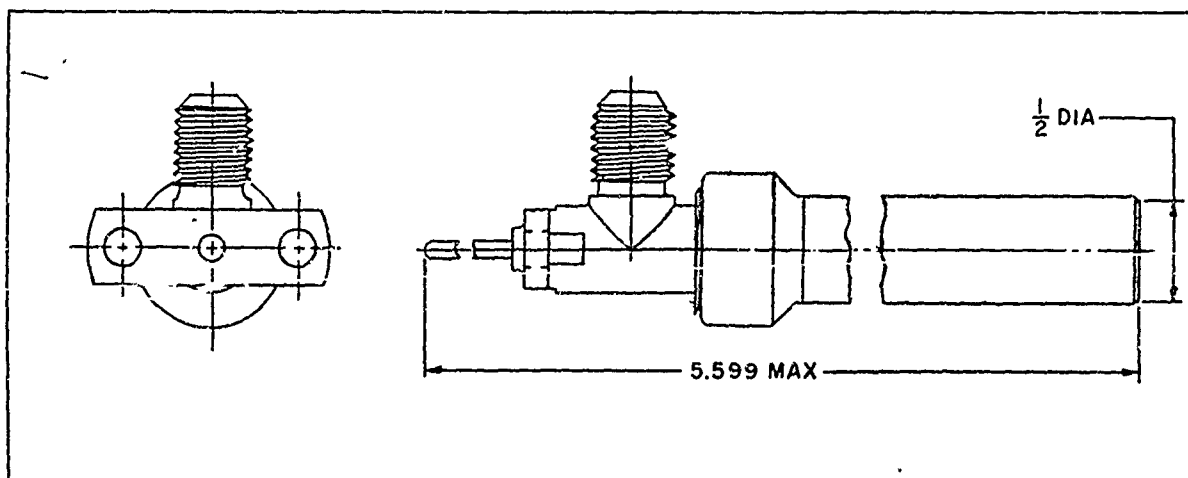
Propellant Actuated Devices

Release, Firing Pin, Gas Actuated, M1A1



CROSS-SECTION DRAWING

Component	Component
A Rod, Piston Assembly	E Cylinder
B Spring, Piston Assembly	F Disc
C "O" Ring (2)	G Piston Assembly
D Ball	H Housing, Piston Assembly



ENVELOPE DRAWING

Propellant Actuated Devices

Gas Generator

GAS GENERATOR, M17

The M17 Gas Generator consists of a constant volume chamber with a pressure outlet port, a gas pressure actuated firing mechanism and an M37 Cartridge.

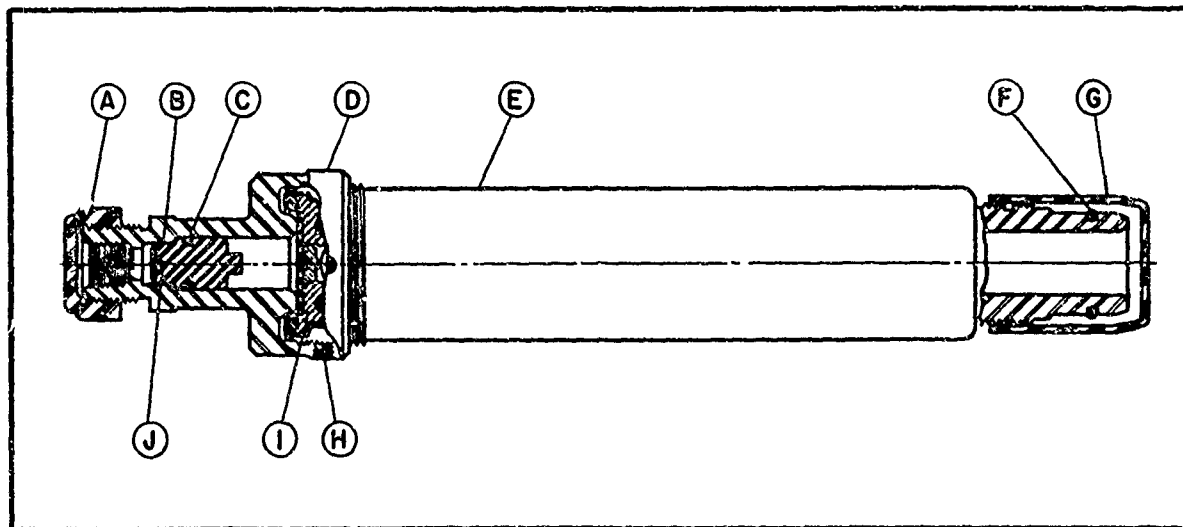
The gas generator is actuated by gas pressure supplied from another cartridge actuated device. The firing pin of the gas generator is held in position with a shear pin. When gas pressure is supplied, the force applied on the firing pin will shear the shear pin and propel the firing pin against the cartridge containing a percussion-sensitive primer. The primer ignites the black powder and propellant contained in the cartridge. The cartridge ruptures at the unsupported area and the propellant gas is utilized to pressurize another device.

PRINCIPAL CHARACTERISTICS

Actuation Method	Gas Pressure
Temperature limits	-65°F to +160°F
Assembly Weight	2.2 lbs
Function Time	200 Milliseconds
Actuation Force	750 psi, min.

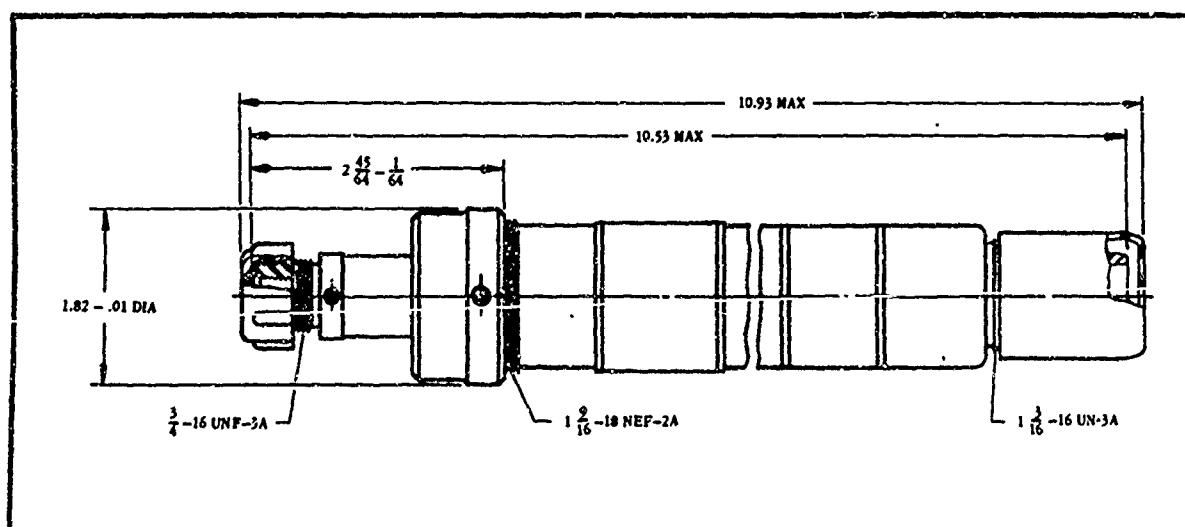
Propellant Actuated Devices

Generator, Gas Pressure, M17



CROSS-SECTION DRAWING

Component	Component
A Cap, Shipping	F "O" Ring
B Pin, Firing	G Cap, Shipping
C "O" Ring	H Setscrew
D Cap, Initiator	I Cartridge Assembly, M57
E Body, Chamber	J Pin, Shear



ENVELC. DRAWING

ELECTRIC IGNITION ELEMENT, M21

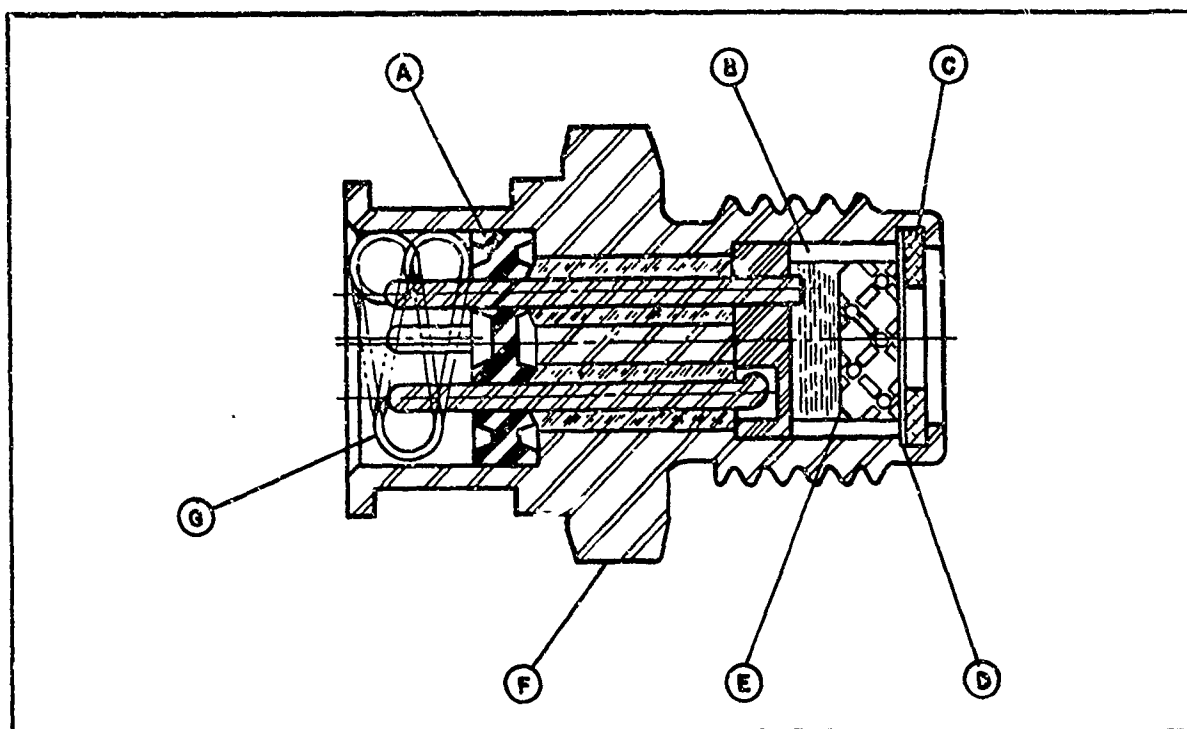
The M21 Electric Ignition Element is designed to be the actuating energy source for other gas actuated Propellant Actuated Devices (PAD). This ignition element has a four pin electrical connector. Two of these pins accommodate a checkout circuit and two pins are used in a firing circuit. The external shell consists of the electrical connector on one end, a hexagonal center section and a 7/16 inch thread on the other end. The threaded portion mates with the gas inlet port of the PAD to be operated. Application of the Fire Stimulus to the firing circuit ignites the propellant charge. The gas generated exerts a force against the firing pin of the other PAD driving it forward to strike its primer thereby causing the device to function.

PRINCIPAL CHARACTERISTICS

Actuation Method	Electric
Bridge Circuit Resistance	0.11 \pm .03 ohm
Temperature limits	-65°F to +200°F
No Fire Stimulus	1.5 amp for 60 seconds
Fire Stimulus	5.0 amp for 50 milliseconds, max.
Pressure Output	2000 to 6000 psi (measured in an 0.062 in. ³ vol.)
Assembled Weight	10.05 gm

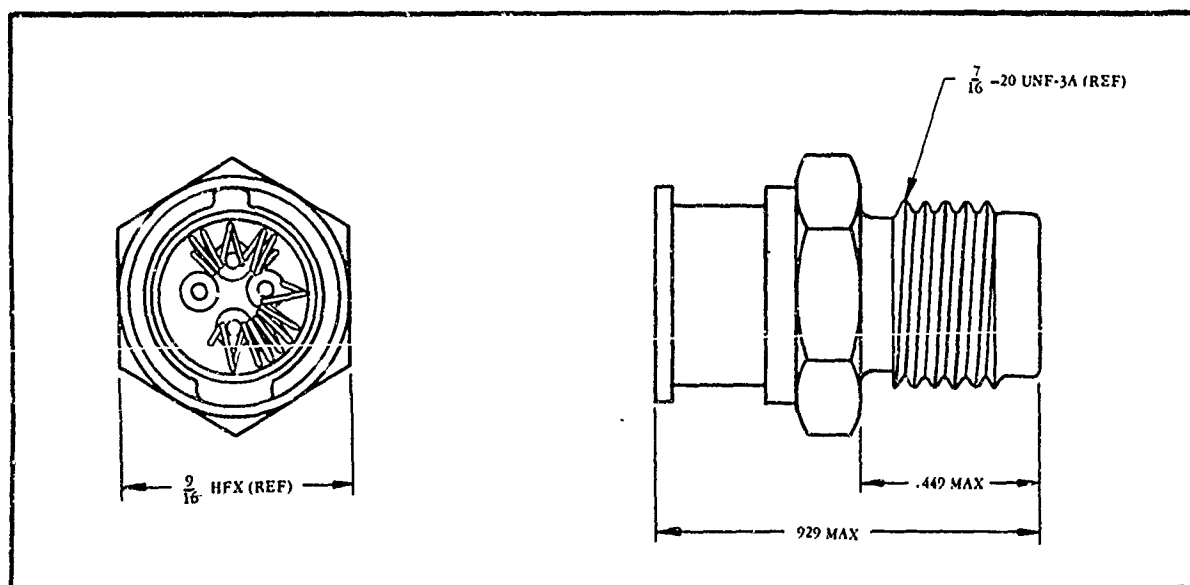
Propellant Actuated Devices

Ignition Element, Electric, M21



CROSS-SECTION DRAWING

Component		Component	
A	Gasket	E	Disc, Inner
B	Sleeve	F	Body Assembly
C	Washer	G	Shunt Assembly
D	Disc, Outer		



ENVELOPE DRAWING

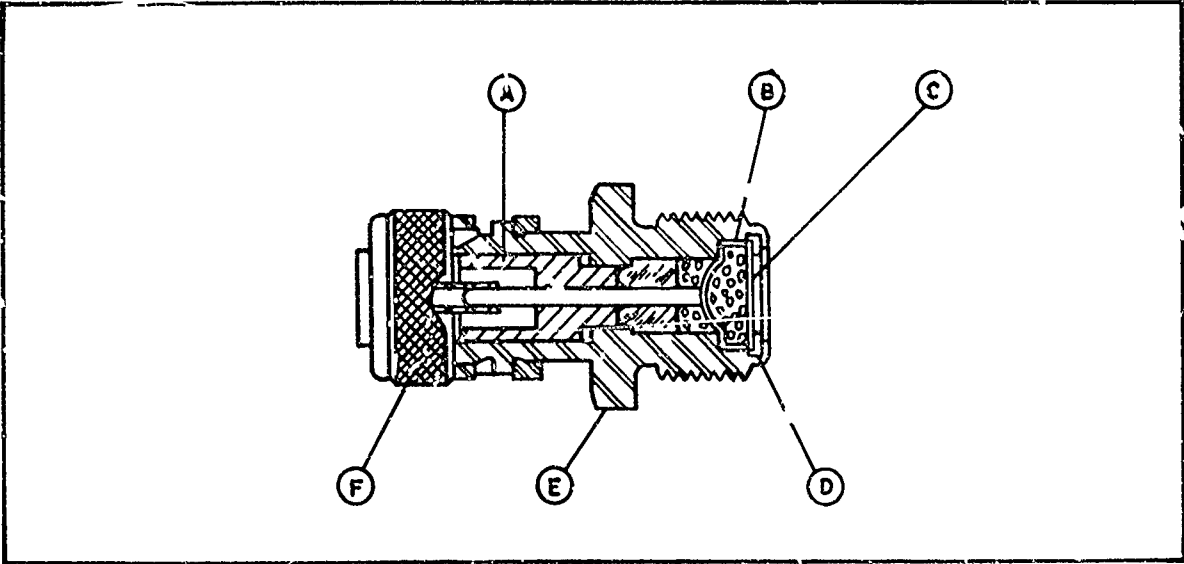
ELECTRIC IGNITION ELEMENT, M55

The M55 Electric Ignition Element is designed to be the actuating energy source for other gas actuated Propellant Actuated Devices (PAD). This ignition element has a single pin coaxial electrical connector. The external shell consists of the electrical connector on one end, a hexagonal center section and a 3/8 inch thread on the other end. The threaded portion mates with the gas inlet port of the PAD to be operated. Application of the Fire Stimulus ignites the propellant charge. The gas generated exerts a force against the firing pin of the other PAD driving it forward to strike its primer thereby causing the device to function.

PRINCIPAL CHARACTERISTICS

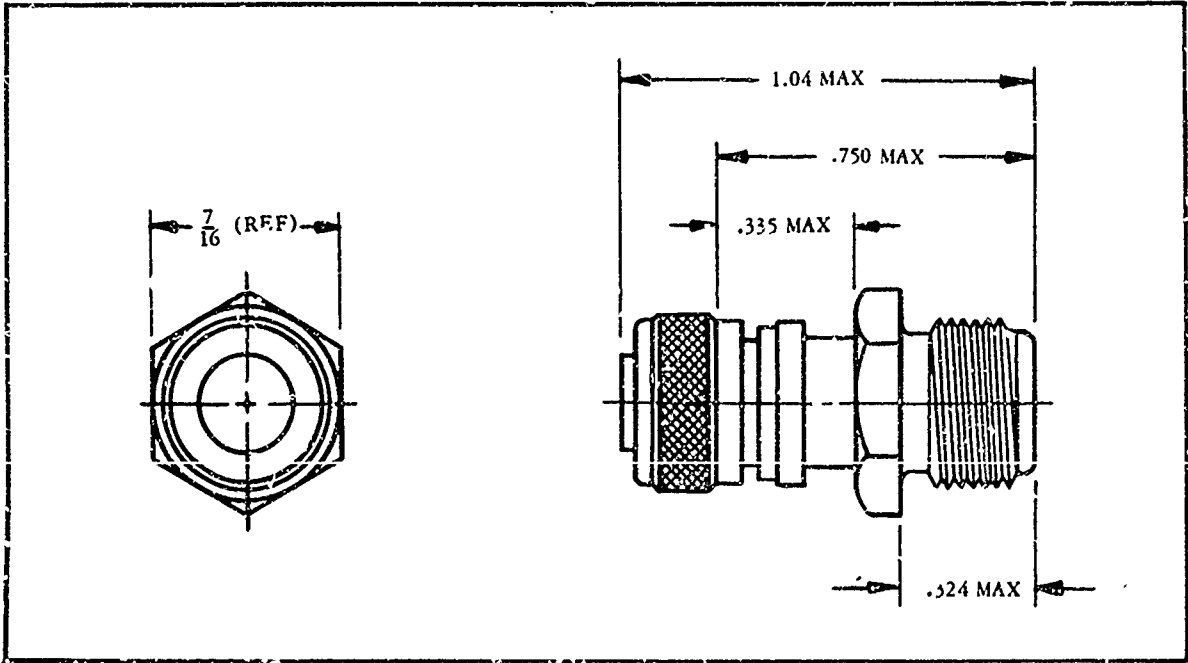
Actuation Method	Electric
Bridge Circuit Resistance	0.11 ± .03 ohm
Temperature limits	-65°F to +200°F
No Fire Stimulus	1.5 amp for 60 seconds
Fire Stimulus	5.0 amp for 50 milliseconds, max.
Pressure Output	2000 to 6000 psi (measured in an 0.062 in. ³ vol.)
Assembled Weight	8.30 gm

Ignition Element, Electric, M55



CROSS-SECTION DRAWING

<u>Component</u>		<u>Component</u>	
A	Insert	D	Ring
B	Sleeve	E	Body Assembly
C	Disc	F	Shunt Assembly



ENVELOPE DRAWING

Unclassified

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13. ABSTRACT This engineering manual provides a description, principal characteristics, cross sectional and envelope drawings, and typical performance of Propellant Actuated Devices (PAD). Sections are included on removers, thrusters, personnel ejection catapults, initiators, cutters, and miscellaneous devices.			

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Unclassified

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